COMS321-Exam1 Key

Question 1:

```
ADD X9, X1, XZR          //X9 = X1
LDUR X10 [X0, X9]        //X10 = array[X9]
loop:
SUB X11, X10, X2         //X11 = X10 - X2
CBZ X11, done            //branch if X11 == 0

SUBI X9, X9, #8          //X9 -= 8
LDUR X10 [X0, X9]        //X10 = array[X9]
CBZ X9, done             //branch if X9 == 0
B loop                   //branch to loop

done:
ADD X0, X10, XZR         //X0 = X10
BR LR                    //return
```

Question 2&3:

Between 1.21 and 1.22

Assuming Total Time = 1s

Other time = Total time - Float time

Other time = 1 - .2 = .8

Float Time (New) = .1 * Float Time = .1 * . 2 = 0.02

Total Time (New) = 0.02 + .8

Total Time (New) = .82

Speedup = Total Time / Total Time (New) = 1 / .82 = 1.22

Question 4:

23, -156, ff64, fbc0, fbc1

Questions 5&6:

ADDI X10, XZR, #512

HEX: 0X910803EA

opcode	immed (12 bits)	Rn	Rd
1001000100	001000000000	11111	01010

SUB X12, X10, XZR

HEX: 0XCB1F014C

opcode	Rm	Shamt	Rn	Rd
11001011000	11111	000000	01010	01100

CBZ X12, end_init (branches to end_init 5 instructions below if X12 == 0)

HEX: 0XB40000AC

opcode	cond. branch address - 5	Rt
10110100	0000000000000000101	01100

STUR X10, [X11, #0]

HEX ; 0XF800016A

opcode	addr	op	Rn	Rt
11111000000	000000000	00	01011	01010

ADD X0, XZR, XZR

HEX: 0X8B1F03E0

opcode	Rm	Shamt	Rn	Rd
10001011000	11111	000000	11111	00000

Questions 7&8:

LDUR X0, [X28, #8]

LDUR	8	0	28	0
11111000010	000001000	00	11100	00000
opcode	addr - 9 bits	op	Rn	Rt

B foo (where foo is 14 instructions above)

B	-14 (negative number - two's complement)
000101	11111111111111111111110010
opcode	branch address

LDUR X30, [X28, #0]

LDUR	0	0	28	30
11111000010	000000000	00	11100	11110
opcode	addr - 9 bits	op	Rn	Rt

ADDI X28, X28, #24

ADDI	24	28	28
1001000100	000000011000	11100	11100
opcode	immed (12 bits)	Rn	Rd

BR LR

BR			LR (30)	
11010110000	00000	000000	11110	00000
opcode	Rm	Shamt	Rn	Rd

Question9: Fixed-length instructions

Question 10:

Registers: X9, X10, and LR --> 3 * 8 = 24

SUBI SP, SP, #24

STUR X9, [SP, #16]

STUR X10, [SP, #8]

STUR LR, [SP, #0]

BL bar

LDUR X9, [SP, #16]

LDUR X10, [SP, #8]

LDUR LR, [SP, #0]

ADDI SP, SP, #24 //delete from the stack