1. 40 points - Convert the following assembly code fragments into machine code using the most efficient addressing mode available (i.e. if possible, use direct instead of extended). Represent your answer as a memory diagram beginning at address $1000.

   a. LDAB $32
      SUBB -5,Y
      STAB $50

Address	Hex Code
1000	D6
1001	32
1002	E0
1003	E9
1004	FB
1005	5B
1007	50
1008	

   b. LDD #9
      CLRA
      STD 25,SP

Address	Hex Code
1000	CC
1001	00
1002	09
1003	87
1004	6C
1005	99
1007	
1008	

Indexed Addressing Postbyte Information

Register	rr
X	00
Y	01
SP	10
PC	11

Postbyte for 5-bit Offset: rr0nnnnn
Postbytes for 9-bit Offset: 111rr00n nnnnnnnn
Postbytes for 16-bit Offset: 111rr010 nnnnnnnn nnnnnnnn

LDAA # 8A → A 8A 10001010
ADDA # $86 → 10001010 + 10000110 = 1 00010000
Based on CCR bit definition: N Z V C = 1 0 1 1

2. 40 points - For each of the code fragments below, determine:

   a. Which of the 8 simple branches (BPL, BMI, BNE, BEQ, BVC, BVS, BCC, BCS) are taken (T), not taken (NT), or cannot be determined (CBD). Note that the Bxx is used to represent a generic branch instruction.

Branch if N=0

	BPL	BMI	BNE	BEQ	BVC	BVS	BCC	BCS
LDAA #$8A	T	NT						
ADDA #$86	NT	T	T	NT	NT	T	NT	T
Bxx 10	if N=0	if N=1	if Z=0	if Z=1	if V=0	if V=1	if C=0	if C=1

   b. Which of the 10 comparison branches (BHI, BHS, BLS, BLO, BGT, BGE, BLE, BLT, BNE, BEQ) are taken (T), not taken (NT), or cannot be determined (CBD). Note that the Bxx is used to represent a generic branch instruction.

Lecture 7 comparison Branches

LDAA A 15
CMPA
9) -(M)
15 - 75 = 30
01110000
N Z V C

	BHI	BHS	BLS	BLO	BGT	BGE	BLE	BLT	BNE	BEQ
LDAA #$A5	T	T	NT	NT	T	T	NT	NT	T	NT
CMPA #$75					CBD	CBD	CBD	CBD		
Bxx 10	if C+Z=0	if C=0	if C+Z=1	if C=1	if Z+(N⊕V)=0	if N⊕V=0	if Z+(N⊕V)=1	if N⊕V=1	if Z=0	if Z=1
	unsigned	unsigned	unsigned	unsigned	signed	signed	signed	signed	both signed & unsigned	

Assuming Instructions are unsign
BGT, BGE, BLE, BLT cannot be determinal since we assumed instructions are unsigned

3. 10 points - Calculate the branch destination using a given offset of $7F if the *beginning address* of a BRA instruction is $2A81.

.0 7F BRA $ 7F

Branch destination: 2B02

4. 10 points - Calculate the branch offset, and determine if it is valid to be used in a BRA instruction, if the *beginning address* of the BRA instruction is $2150 and the branch destination address is $2080.

Destination 2080

Branch offset: _____

$2150 20
$2151
$2152

2A81 20
2A82 7F
Quiz 2 2A83

2A83 + 7F = 2B02

2152 - 2080 = D2

$2152 - $80 = 20D2
$2152 + $7F = 21D1
Valid destination ≈ 20D2 ~ 21D1