ENCS336 – Second Exam

Question 4: **(20 marks)**
Given a CPU with the following resources:
AC: general-purpose register
A, B, C, D, Y: memory addresses containing numeric data.

Write 4 pieces of code to execute the expression [Y = (A + B) * (C - D)] using:

a) *Zero-address instructions*
b) One-address instructions
c) Two-address instructions
d) Three-address instructions

Instructions available to you are:
MOVE, STOR, ADD, SUB (*subtract*), MPY (*multiply*), PUSH, POP

A)

	Comment
	T top of memory stack
PUSH A	T ← A , T++
PUSH B	T ← B, T++
ADD	T ← T_{-1} + T
POP X	X ← T , T- -
PUSH C	T ← C , T++
PUSH D	T ← D, T++
SUB	T ← T_{-1} - T
PUSH X	T ← X , T++
MPY	T ← T_{-1} * T
POP Y	Y ← T , T- -

B)

	Comment
MOVE C	AC ← C
SUB D	AC ← AC – D
STOR Y	Y ← AC
MOV A	AC ← A
ADD B	AC ← AC + B
MYP Y	AC ← AC * Y
STOR Y	Y ← AC

C)

	Comment
MOVE Y, A	Y ← A
ADD Y , B	Y ← Y + B
MOVE T, C	T ← C
SUB T, D	T ← T – D
MPY Y, T	Y ← Y * T

D)

	Comment
ADD Y, A, B	Y ← A + B
SUB T, C, D	T ← C - D
MPY Y, Y, T	Y ← Y * T

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<u>Question 5:</u> (15 marks)

Assume that an 8086 style computer has an unlimited amount of memory. Each memory location is 16 bits (2 bytes) wide word. A word with address ***I*** contains a binary number equal to ***2*I***. So location number 50 has the binary number corresponding to 100, and location 170 has the binary number corresponding to 340, and location 6530 has the binary number corresponding to 13060, and so on. Assuming that AX has the initial value of 1000 and BX = 500, Show the value of AX after each of the following:

ADD AX, Z, where Z is

Address	Memory
:	:
50	100
:	:
170	340
:	:
500	1000
:	:
800	1600
:	:
1003	2006
:	:
2006	4012
:	:
6530	13060
:	:

Registers

AX	1000
BX	500

1. Z= 1003, immediate addressing

Operand = A

AX ← 1000 + 1003 = **2003**

2. Z=1003, direct memory addressing

EA = A = 1003

AX ← 1000 + 2006 = **3006**

3. Z=1003, Indirect memory addressing

EA = (A) = (1003) = 2006

AX ← 1000 + 4012 = **5012**

4. Z= BX, register direct addressing

EA = R

AX = 1000 + 500 = **1500**

5. Z=[BX] register indirect addressing

EA = (R) = 500

AX = 1000 + 1000 = **2000**

6. Z=[BX]+300, base-offset addressing.

EA = (R+300) = 800

AX = 1000 + 1600 = **2600**