P8) Write a program that can evaluate the expression $A \times B - C \times D$

Logic Used

Firstly, we load both A and B onto the accumulator. To perform their multiplication, we run through a loop to perform the multiplication and end it once we reach the final bit. Similarly, we perform the multiplication of C and D. For the subtraction step, we take the complement of RESULT_2(product of C and D) and add 1 to it to get its 16's complement. We, then, simply add RESULT_1(product of A and B) to get our desired result and store it in RESULT_3.

Other conditions: We check whether A or B are zero. If either of them are zero, we skip to multiplying C and D by branching there unconditionally (BUN SKIP). Similarly, we skip to performing the subtraction (BUN SUBTRACT) if either C or D are zero.

Program

```
LDA A
SZA
BUN B_0_CHECK
BUN SKIP

B_0_CHECK, LDA B
SZA
BUN MUL_1
BUN SKIP

MUL_1, LDA RESULT_1
ADD A
STA RESULT_1
LDA MUL_COUNTER_1
INC
STA MUL_COUNTER_1
CMA
AND B
SZA
BUN MUL_1

SKIP, LDA C
SZA
BUN D_0_CHECK
BUN SUBTRACT

D_0_CHECK, LDA D
SZA
BUN MUL_2
BUN SUBTRACT
```

```
MUL_2, LDA RESULT_2
ADD C
STA RESULT_2
LDA MUL_COUNTER_2
INC
STA MUL_COUNTER_2
CMA
AND D
SZA
BUN MUL_2

SUBTRACT, LDA RESULT_2
CMA
INC
ADD RESULT_1
STA RESULT_3

END, HLT
```

Input 1

```
A, HEX 0009
B, HEX 000C
C, HEX 0005
D, HEX 0007
MUL_COUNTER_1, HEX 0000
MUL_COUNTER_2, HEX 0000
RESULT_1, HEX 0000
RESULT_2, HEX 0000
RESULT_3, HEX 0000
```

Result 1

```
0049
```

Output 1

A	02A	HEX 0009	0009
B	02B	HEX 000C	000C
C	02C	HEX 0005	0005
D	02D	HEX 0007	0007
MUL_COUNTER_1	02E		000C
MUL_COUNTER_2	02F		0007
RESULT_1	030		006C
RESULT_2	031		0023
RESULT_3	032		0049

Input 2

```
A, HEX 0000
B, HEX 000C
C, HEX 0005
D, HEX 0007
MUL_COUNTER_1, HEX 0000
MUL_COUNTER_2, HEX 0000
RESULT_1, HEX 0000
RESULT_2, HEX 0000
RESULT_3, HEX 0000
```

Result 2

```
FFDD
```

Output 2

A	02A	HEX 0000	0000
B	02B	HEX 000C	000C
C	02C	HEX 0005	0005
D	02D	HEX 0007	0007
MUL_COUNTER_1	02E	HEX 0000	0000
MUL_COUNTER_2	02F		0007
RESULT_1	030	HEX 0000	0000
RESULT_2	031		0023
RESULT_3	032		FFDD

Input 3

```
A, HEX 0009
B, HEX 000C
C, HEX 0005
D, HEX 0000
MUL_COUNTER_1, HEX 0000
MUL_COUNTER_2, HEX 0000
RESULT_1, HEX 0000
RESULT_2, HEX 0000
RESULT_3, HEX 0000
```

Result 3

```
006C
```

Output 3

A	02A	HEX 0009	0009
B	02B	HEX 000C	000C
C	02C	HEX 0005	0005
D	02D	HEX 0000	0000
MUL_COUNTER_1	02E		000C
MUL_COUNTER_2	02F	HEX 0000	0000
RESULT_1	030		006C
RESULT_2	031	HEX 0000	0000
RESULT_3	032		006C