

Program Description I

Program Title MULTIPLICATION OF A 25-DIGIT NUMBER BY A 25-DIGIT NUMBER

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Program Description, Equations, Variables LET A 25-DIGIT NUMBER BE REPRESENTED AS FOLLOWS: GROUP ITS DIGITS INTO 5 SETS OF 5 DIGITS EACH. CALL THE RIGHTMOST a_0 , THE NEXT $a_1, \dots$, UP TO THE LEFTMOST (a_4). LABEL THE 25 DIGIT MULTIPLIER SIMILARY (USE $b_0, \dots, b_4$ INSTEAD OF $a_0, \dots, a_4$). THEN:

$$\begin{array}{r} a_4 a_3 a_2 a_1 a_0 \\ \times b_4 b_3 b_2 b_1 b_0 \\ \hline \end{array}$$

$$c_9 c_8 c_7 c_6 c_5 c_4 c_3 c_2 c_1 c_0$$

WHERE THE c_l 'S ARE ALSO GROUPS OF 5 DIGITS, COMPUTED BY

$$c_l = \sum_{\substack{j+k=l \\ j,m=0-4}} \left\{ \text{INT} \left(\frac{a_j b_m}{10^5} \right) + 10^5 \text{FRAC} \left(\frac{a_j b_m}{10^5} \right) \right\} \quad 0 \leq l < 9$$

AND $c_0 = \text{FRAC} \left(\frac{a_0 b_0}{10^5} \right) \times 10^5$, $c_9 = \text{INT} \left(\frac{a_4 b_4}{10^5} \right)$

IF ANY GROUPING LIKE 362,56281,... IS ENCOUNTERED, SET $a_0 = 56281$, $a_1 = 00362$. THE SAME IS TRUE FOR OUTPUT.

AS AN EXAMPLE, 2,430,658,100,328 WOULD BE GROUPED AS:

$$\left. \begin{array}{l} a_0 = 00328 \\ a_1 = 06581 \\ a_2 = 00243 \end{array} \right\} \text{ AND OUTPUT AS } \left\{ \begin{array}{l} c_2 = 243 \\ c_1 = 6581 \\ c_0 = 328 \end{array} \right. \text{ PUTTING}$$

ZERO(S) IN FRONT OF THOSE GROUPINGS WITH LESS THAN 5 DIGITS GIVES YOUR ANSWER

Operating Limits and Warnings INPUT DATA IS NOT CHECKED. HENCE INVALID INPUT RESULTS IN INVALID ANSWERS

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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Sketch(es)

Sample Problem(s) ① $576,460,752,303,423,488$
 $\times 144,115,188,075,855,872$

3,486,784,401

3,486,784,401

8,3076,749736,557,242,056,487,941,267,521,536 12,157,665,459,056,928,801

NOTE THAT MULTIPLIERS AND MULTIPLICAND ARE INPUT FROM THE LAST DIGIT FORWARD (IE. START WITH THE 8 AND END WITH THE 5) AND ARE INPUT IN GROUPS OF 5.

BUT THE PRODUCT IS OUTPUT FROM LEFT TO RIGHT, AGAIN IN GROUPS OF 5.

Solution(s) ① $A \rightarrow 0.$	$144 [RIS] \rightarrow -4.$	$48794.$	$84401 [RIS] \rightarrow -1.$	$0.$
$23488 [RIS] \rightarrow 1.$	$0 [RIS] \rightarrow$	$12675,$	$34867 [RIS] \rightarrow -2.$	$0.$
$23034 [RIS] \rightarrow 2.$	ANSWER: $0.$	$21536.$	$0 [RIS] \rightarrow -3.$	$12157.$
$46075 [RIS] \rightarrow 3.$	$0.$	② $A \rightarrow 0.$	$0 [RIS] \rightarrow -4.$	$66545.$
$576 [RIS] \rightarrow 4.$	$0.$	$84401 [RIS] \rightarrow 1.$	$0 [RIS] \rightarrow$	$90569.$
$0 [RIS] \rightarrow 0.$	$83076.$	$34867 [RIS] \rightarrow 2.$	ANSWER: $0.$	$28801.$
$55872 [RIS] \rightarrow -1.$	$74973.$	$0 [RIS] \rightarrow 3.$	$0.$	
$80758 [RIS] \rightarrow -2.$	$65572,$	$0 [RIS] \rightarrow 4.$	$0.$	
$11518 [RIS] \rightarrow -3.$	$42056.$	$0 [RIS] \rightarrow 0.$	$0.$	

Reference(s)

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	f LBL A	31 25 11			STO + (i)	33 61 24	$10^5 \text{FRC}(\frac{R_E}{10^5}) + R_{(i)} \rightarrow R_{(i)}$
	f CLREG	31 43	INITIALIZE		f DSZ	31 33	$\text{INT}(\frac{R_E}{10^5}) + R_{(i+1)} \rightarrow R_{(i+1)}$
	0	00			RCL E	34 15	
	ENTER ↑	41		060	q GSB fe	32 22 15	$10^5 \text{FRC}(R_D/10^5) + R_{(i+1)} \rightarrow R_{(i+1)}$
	f LBL 3	31 25 03			STO + (i)	33 61 24	$\text{INT}(R_D/10^5) + R_{(i+2)} \rightarrow R_{(i+2)}$
	h xzy	35 52	LOAD FIRST		RCL D	34 14	
	R/S	84	NUMBER		q GSB fd	32 22 14	
	STO (i)	33 24			STO + (i)	33 61 24	
	f ISZ	31 34			f DSZ	31 33	
010	h RCI	35 34			RCL D	34 14	
	5	05			q GSB fe	32 22 15	
	q xzy	32 81			STO + (i)	33 61 24	
	GTO 3	22 03			RCL C	34 13	$10^5 \text{FRC}(R_C/10^5) + R_{(i+2)} \rightarrow R_{(i+2)}$
	1	01	INITIALIZE	070	q GSB fd	32 22 14	
	0	00			STO + (i)	33 61 24	
	f LBL 4	31 25 04	LOAD SECOND		f DSZ	31 33	
	-	51	NUMBER		RCL C	34 13	$\text{INT}(R_C/10^5) + R_{(i-3)} \rightarrow R_{(i-3)}$
	5	05			q GSB fe	32 22 15	
	+	61			STO + (i)	33 61 24	
020	CHS	42			RCL B	34 12	$10^5 \text{FRC}(R_B/10^5) + R_{(i-3)} \rightarrow R_{(i-3)}$
	R/S	84			q GSB fd	32 22 14	
	STO (i)	33 24			STO + (i)	33 61 24	
	f ISZ	31 34			f DSZ	31 33	
	h RCI	35 34		080	RCL B	34 12	$\text{INT}(R_B/10^5) + R_{(i-4)} \rightarrow R_{(i-4)}$
	1	01			q GSB fe	32 22 15	
	0	00			STO + (i)	33 61 24	
	q xzy	32 81			RCL A	34 11	$10^5 \text{FRC}(R_A/10^5) + R_{(i-4)} \rightarrow R_{(i-4)}$
	GTO 4	22 04			q GSB fd	32 22 14	
	f PZS	31 42	INITIALIZE FOR		STO + (i)	33 61 24	
030	f CLREG	31 43	MULTIPLICATION		f DSZ	31 33	
	5	05			h SPC	35 84	$\text{INT}(R_A/10^5) + R_{(i-5)} \rightarrow R_{(i-5)}$
	h STI	35 33			RCL A	34 11	
	f LBL 1	31 25 01	PREPARE FOR	090	q GSB fe	32 22 15	
	f PZS	31 42	SUMS		STO + (i)	33 61 24	$i+1 \rightarrow R_I$
	RCL (i)	34 24	$b_I \cdot a_0 \rightarrow R_A$		f ISZ	31 34	$(i.e. R_I + 6 \rightarrow R_I)$
	RCL 0	34 00			f ISZ	31 34	
	x	71			f ISZ	31 34	
	STO A	33 11			f ISZ	31 34	
	RCL (i)	34 24	$b_I \cdot a_1 \rightarrow R_B$		f ISZ	31 34	
040	RCL 1	34 01			f ISZ	31 34	
	x	71			h RCI	35 34	IF $R_I = 10$, THE
	STO B	33 12			1	01	MULTIPLICATION IS
	RCL (i)	34 24	$b_I \cdot a_2 \rightarrow R_C$		0	00	COMPLETE. IF NOT,
	RCL 2	34 02		100	q xzy	32 81	GO BACK.
	x	71			GTO 1	22 01	
	STO C	33 13			0	00	INITIALIZE FOR
	RCL (i)	34 24	$b_I \cdot a_3 \rightarrow R_D$		h STI	35 33	CORRECTION
	RCL 3	34 03			f LBL 0	31 25 00	IF ANY C _i HAS MORE
	x	71			RCL (i)	34 24	THAN FIVE DIGITS,
050	STO D	33 14			q GSB fd	32 22 14	ADD THE EXTRA DIGITS
	RCL (i)	34 24	$b_I \cdot a_4 \rightarrow R_E$		ENTER ↑	41	TO C _{i+1} AND DROP
	RCL 4	34 04			ENTER ↑	41	THEM FROM C _i .
	x	71			EEX	43	
	STO E	33 15		110	5	05	
	f PZS	31 42			x	71	
	q GSB fd	32 22 14			STO - (i)	33 51 24	

REGISTERS									
0 C_0	1 C_1	2 C_2	3 C_3	4 C_4	5 C_5	6 C_6	7 C_7	8 C_8	9 C_9
S0 a_0	S1 a_1	S2 a_2	S3 a_3	S4 a_4	S5 b_0	S6 b_1	S7 b_2	S8 b_3	S9 b_4
A USED	B USED	C USED	D USED	E USED	F REGISTER CONTROL	G	H	I	J

