

04338D Program Description I

Program Title FAST COMBINATIONS, PERMUTATIONS, AND FACTORIALS

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Program Description, Equations, Variables THIS PROGRAM COMPUTES COMBINATIONS, PERMUTATIONS, AND FACTORIALS FOR POSITIVE INTEGERS UP TO AND INCLUDING 10^{98} . AVERAGE ACCURACY IS SEVEN SIGNIFICANT DIGITS, AND AVERAGE RUN TIME IS LESS THAN NINE SECONDS. METHOD USED:

COMBINATIONS OF n ITEMS TAKEN r AT A TIME = $C_r^n = \frac{n!}{r!(n-r)!}$

PERMUTATIONS OF n ITEMS TAKEN r AT A TIME = $P_r^n = \frac{n!}{(n-r)!}$

FOR FACTORIALS, WHEN $n \leq 69$ THE BUILT IN $N!$ FUNCTION IS USED. WHEN $n > 69$ THE FOLLOWING APPROXIMATION IS USED:

$$n! \cong \text{antilog} \left[n \log \frac{n}{e} + \log \sqrt{2\pi n} + \log \left(1 + \frac{1}{12n} \right) \right]$$

WHEN THE POWER OF TEN EXPONENT EXCEEDS 10^{99} FOR THE RESULT, IT IS SHOWN SEPERATELY, AS THE SECOND NUMBER DISPLAYED.

Operating Limits and Warnings ONLY THE ABSOLUTE VALUE OF THE INTEGER PORTION OF n IS USED; n MUST BE LESS THAN OR EQUAL TO 10^{98} . FOR COMBINATIONS AND PERMUTATIONS, r MUST BE LESS THAN OR EQUAL TO n . ACCURACY DETERIORATES WITH EXTREMELY LARGE NUMBERS.

NOTE: LABEL 4 IS USED TO GENERATE ERROR MESSAGE.

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 USING A STANDARD 52 CARD DECK, HOW MANY POSSIBLE HANDS COULD YOU RECEIVE IF YOU ARE DEALT 5 CARDS?

② IF A CYPHER LOCK USES A 4-DIGIT CODE TO OPEN A DOOR, AND THE NUMBERS 0 THROUGH 9 MAY BE USED IN ANY ORDER, HOW MANY UNIQUE CODES EXIST?

③ WHAT IS THE FACTORIAL OF 521?

Solution(s) ① SINCE THE ORDER IN WHICH YOU ARE DEALT YOUR 5 CARDS DOES NOT MATTER, WE COMPUTE THE POSSIBLE COMBINATIONS OF 52 ITEMS TAKEN 5 AT A TIME: $\boxed{5} \boxed{2} \boxed{\text{ENTER}} \boxed{5} \boxed{A} \rightarrow 2598960$

② SINCE THE ORDER OF THE NUMBERS MATTERS IN THIS CASE, WE COMPUTE THE PERMUTATIONS OF 10 ITEMS TAKEN 4 AT A TIME: $\boxed{1} \boxed{0} \boxed{\text{ENTER}} \boxed{4} \boxed{B} \rightarrow 5040$

③ $\boxed{5} \boxed{2} \boxed{1} \boxed{C} \rightarrow 9.1750 \rightarrow 1190$ WHICH MEANS 9.1750×10^{1190}

Reference(s) VAN NOSTRAND'S SCIENTIFIC ENCYCLOPEDIA, FIFTH EDITION, PAGE 1733, VAN NOSTRAND REINHOLD COMPANY, 1976

FAST COMBINATIONS, PERMUTATIONS, AND FACTORIALS

$$\boxed{(hp)} \quad n \uparrow r \rightarrow C_r^n \quad n \uparrow r \rightarrow P_r^n \quad n \rightarrow n!$$
[illegible]

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Program Listing I

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STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL C	31 25 13	FACTORIAL		ABS	35 64	
	GSB 2	31 22 02	COMMAND		6	06	
	STO 0	33 00	ROUTINE		9	09	
	GTO 0	22 00		060	X \neq Y	35 52	
	*LBL B	31 25 12			X > Y	32 81	
	SF 2	35 51 02	COMBINATION		GTO 3	22 03	
	*LBL A	31 25 11	OR		N!	35 81	
	X > Y	32 81	PERMUTATION		LOG	31 53	
	GTO 4	22 04			RTN	35 22	
010	STO 1	33 01	COMMAND		*LBL 3	31 25 03	
	R \downarrow	35 53	ROUTINE		EEX	43	
	GSB 2	31 22 02			e ^x	32 52	
	STO 0	33 00			\div	81	
	RCL 2	34 02		070	LOG	31 53	
	RCL 1	34 01			RCL 2	34 02	
	-	51			X	71	
	GSB 2	31 22 02			TT	35 73	
	STO - 0	33 51 00			Z	02	
	F? 2	35 71 02			X	71	
020	GTO 0	22 00			RCL 2	34 02	
	RCL 1	34 01			X	71	
	GSB 2	31 22 02			\sqrt{x}	31 54	
	STO - 0	33 51 00			LOG	31 53	
	*LBL 0	31 25 00		080	+	61	
	RCL 0	34 00	DISPLAY		RCL 2	34 02	
	INT	31 83	ROUTINE		1	01	
	9	09			2	02	
	9	09			X	71	
	X \neq Y	35 52			1/x	35 62	
030	X > Y	32 81			EEX	43	
	GTO 1	22 01			+	61	
	RCL 0	34 00			LOG	31 53	
	10 ^x	32 53			+	61	
	DSP 0	23 00		090	RTN	35 22	END
	-x-	31 84					
	RTN	35 22					
	*LBL 1	31 25 01					
	RCL 0	34 00					
	FRAC	32 83					
040	10 ^x	32 53					
	DSP 4	23 04					
	-x-	31 84					
	RCL 0	34 00					
	INT	31 83		100			
	DSP 0	23 00					
	-x-	31 84					
	RTN	35 22					
	*LBL 2	31 25 02	FACTORIAL				
	STO 2	33 02	SUBROUTINE				
050	EEX	43					
	9	09					
	8	08					
	X \neq Y	35 52					
	X > Y	32 81		110			
	GTO 4	22 04					
	INT	31 83					

REGISTERS

0	1	2	3	4	5	6	7	8	9
USED	r	USED							
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

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LIBRARY KEY CODE

[illegible]