

UNIVERSITY OF ILLINOIS  
DIGITAL COMPUTER

LIBRARY ROUTINE SA 3 - 155

TITLE: Natural Logarithm (DOI or SADOI)  
TYPE: Subroutine (entered with 8J order from Library Routine A1  
TIME: 15 milliseconds  
NUMBER OF WORDS: 30  
BRIEF DESCRIPTION: The subroutine determines the natural logarithm of an arbitrary (positive) number which lies in the floating accumulator in the standard form [i.e.  $(1/10 \leq A \leq 1)$  where A is the fractional part]. Control is returned after computation to the next floating order.  
ACCURACY: At all times the accuracy of the floating point routine is available (provided the argument was in its standard form initially). For arbitrary exponent there is a maximum error of  $\pm 1$  in the 9th decimal place.  
TEMPORARY STORAGE: 0, 1, 2  
METHOD OF USE: Enter with an 8J order from a set of interpretive orders with the argument in standard form in the floating accumulator. After calculation, control returns to word 19 of Library Routine A1.  
RESULT: The result appears in the floating accumulator in standard form.  
PRESET PARAMETER: S 3 Floating accumulator  
                  1 S 3  
                  S 4 address of first word of Library Routine A1  
REMARKS: If the argument is a negative number or 0 the program will stop on a division hang-up.

RT: 10/13/60

DATE	November 9, 1954
CODED BY	Lily Seshu
APPROVED BY	J. P. Nash

LOCATION	GRADE	NOTES	PAGE 1
0	00 E (SA) L5 183 L0 4184		
1	40 2F 50 20L	Form $p/400 \ln 10$	
2	75 2F 85 F		
3	40 F F5 13084	Adjust exponent for scaling	
4	42 1S3 L5 S3		
5	L4 19L 40 1F		
6	L5 S3 F0 19L	Form $y = \frac{\frac{A}{2} - \frac{1}{2\sqrt{10}} - 2^{-39}}{\frac{A}{2} + \frac{1}{2\sqrt{10}}}$	
7	66 1F 85 22L		
8	40 1F 7J 1F		
9	40 2F L5 7L		
10	42 11L 50 21L		
11	7J 2F L4 ( )L	Compute $1/200 \ln y$	
12	40 S3 50 S3		
13	F5 11L 40 11L		
14	L0 18L 36 11L		
15	7J 1F L0 20L		
16	L4 F L4 F	Compute $1/200 [\ln y - \ln \sqrt{10} + p \ln 10]$	
17	40 S3 26 19S4		

LOCATION	ORDER	NOTES	PAGE 2
18	LJ 2F L4 30L	End constant	
19	00 F 00 15811 38830 00J	$1/2 \sqrt{10}$	
20	00 F 00 57564 62732 J	$1/200 \log \sqrt{10}$	
21	00 F 00 32085 28548 J	$C_{17}/200 = 0.003208528548$	
22	NO F 00 49832 89053 80J	$C_{15}/200 = -0.001671094620$	
23	00 F 00 17477 06534 J	$C_{13}/200 = 0.001747706534$	
24	00 F 00 68285 8823J	$C_{11}/200 = 0.000682858823$	
25	00 F 00 11410 16968 J	$C_9/200 = 0.001141016968$	
26	00 F 00 14263 85504 J	$C_7/200 = 0.001426385504$	
27	00 F 00 20000 79233 J	$C_5/200 = 0.002000079233$	
28	00 F 00 33333 32235 J	$C_3/200 = 0.003333332235$	
29	00 F 00 10000 00000 0J	$C_1/200 = 0.010000000000$	