

Program Title TRIANGLE SOLUTION-- AUTOMATEDContributor's Name Keith JarettAddress 1540 Mathews AveCity Manhattan Beach State/Country CA Zip Code 90266

Program Description, Equations, Variables If all 3 sides are given, the program finds the 3 angles using the law of cosines ($c^2 = a^2 + b^2 - 2ab \cos C$). If 2 sides are given, the program first finds the third side so that the above procedure can be applied. If the angle between the two sides was supplied, the law of cosines gives the missing side. If another angle is supplied, the side-side-angle problem (SSA) has 2 solutions. The user selects which solution is desired and the law of sines ($\sin A / a = \sin B / b$) gives the missing side. If one side and two angles are supplied, the missing angle is calculated ($A+B+C = 180$ or π) and the law of sines allows calculation of the 2 missing sides.

Necessary Accessories none

Operating Limits and Warnings 1.) Incomplete input (e.g. 3 angles, no sides) will yield the error message INSUFFICIENT. 2.) If an SSA case is given in which the angle is too large, no triangle is possible and DATA ERROR results. 3.) If you have plug-in memory, consider replacing line 25 (CLRG) with $\emptyset$ STO $\emptyset 1$ STO $\emptyset 2$ STO $\emptyset 3$

Reference(s) STO $\emptyset 4$ STO $\emptyset 5$ STO $\emptyset 6$ to avoid loss of other data.

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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003920 USER INSTRUCTIONS

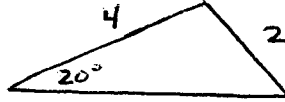
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SIZE:
(HP-41C) 007

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
0.	Clear key assignments unless you have a memory module			
1.	Set SIZE, enter the program, set USER mode.			
2.	To clear old data		[D]	
3.	Enter triangle data (known parts)			
	Side a	a	[A]	a
	Side b	b	[B]	b
	Side c	c	[C]	c
	Angle A	A	[A]	A
	Angle B	B	[B]	B
	Angle C	C	[C]	C
4.	Compute missing parts		[E]	see note 1.
5.	Request computed values in any order			
	Side a		[A]	a
	Side b		[B]	b
	Side c		[C]	c
	Angle A		[A]	A
	Angle B		[B]	B
	Angle C		[C]	C
Note 1. Program messages are to be interpreted as follows:				
	INSUFFICIENT-- Data supplied does not allow solution. Go to step 3.			
	DATA ERROR-- An impossible SSA problem was given. No solution exists.			
	- SOL. 0 OR 1 -- An ambiguous SSA problem was given. Two solutions exist.			
	Solution 0 is the larger triangle, solution 1 the smaller.			
	Key in 0 or 1 and push R/S to restart.			
	When the program halts with a number in the display, proceed to step 5.			

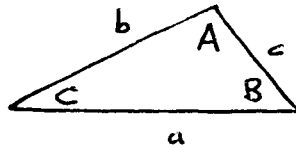
TRIANGLE SOLUTION

Find the missing components of the following triangle:



Designation of triangle components is as follows:

Sides: a
 b
 c



Angles: A
B
C

opposite corresponding sides

SOLUTION:

[illegible]

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PROGRAM LISTING

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS	STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01	LBL a		Side a	45	XEQ 93		
02	1		in register 01	46	X=0?		
03	GTO 09			47	GTO 03		Two nonzero sides
04	LBL b		Side b	48	RDN		Else one side only
05	2		in register 02	49	XEQ 13		Recall and test
06	GTO 09			50	X=0?		angle I
07	LBL c		Side c in	51	GTO 08		(need two nonzero
08	3		register 03	52	RDN		angles)
09	GTO 09		Angle A in	53	XEQ 95		Recall and test
10	LBL A		register 04	54	X=0?		next angle
11	4		Angle B in	55	GTO 04		
12	GTO 09		register 05	56	XEQ 95		Recall and test
13	LBL B		Angle C in	57	X=0?		next angle
14	5		register 06	58	GTO 04		
15	GTO 09			59	XEQ 11		Calculate third
16	LBL C			60	XEQ 92		angle
17	6			61	X<>Y		
18	LBL 09			62	GTO 07		
19	RDN			63	LBL 08		
20	FS?C 22			64	XEQ 95		
21	STO IND		Store if data	65	X=0?		
T			was entered	66	GTO 09		
22	RCL IND		Otherwise	67	X<>Y		
T			just recall	68	XEQ 11		Find third an
23	RTN			69	GTO 07		
24	LBL D		Initialize	70	LBL 09		
25	CLRG			71	RDN		
26	RTN			72	XEQ 95		
27	LBL E		Solve	73	X=0?		
28	1.003			74	GTO 04		
29	STO 00			75	X<>Y		
30	LBL 01			76	XEQ 91		
31	RDN			77	XEQ 11		Find third angle
32	RCL IND			78	RDN		
00				79	XEQ 95		
33	X=0?		Find a nonzero	80	LBL 07		Find two missing
34	GTO 09		side	81	SIN		sides using law
35	ISG 00			82	X<>Y		of sines.
36	GTO 01			83	SIN		
37	LBL 04			84	XEQ 92		
38	"INSUFFI			85	XEQ 13		
CIENT"				86	SIN		
39	PROMPT			87	R↑		
40	LBL 09			88	/		
41	XEQ 93		Increment I,	89	/		
42	X=0?		is side I = 0.	90	X<>Y		
43	GTO 02		Two nonzero sides	91	LASTX		
44	RDN			92	/		

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS	STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
93	XEQ	91		137	R-P		
94	STO	IND	Store two missing sides	138	STO	IND	
00				00			
95	RDN			139	*LBL	07	Find 3 angles given 3 sides
96	XEQ	91		140	1.003		
97	STO	IND		141	STO	00	
00				142	*LBL	00	Apply law of cosines 3 times
98	RTN			143	XEQ	93	
99	*LBL	02	Two nonzero sides	144	XEQ	93	
100	XEQ	93		145	R-P		
101	X=0?			146	XEQ	93	
102	GTO	07	Three nonzero sides	147	X<>Y		
103	RDN			148	/		
104	GTO	09		149	X↑2		
105	*LBL	03		150	1		
106	X<>Y			151	X<>Y		
107	XEQ	92		152	-		
108	*LBL	09		153	X<>Y		
109	XEQ	13	Check angle I	154	ENTER↑		
110	X=0?			155	+		
111	GTO	05		156	SIN		
112	RDN			157	/		
113	XEQ	95	Check next angle	158	ACOS		
114	X=0?			159	XEQ	12	
115	GTO	09		160	ISG	00	
116	XEQ	06	Find missing side by law of sines	161	GTO	00	
117	XEQ	92		162	RTN		
118	STO	IND		163	*LBL	06	Find missing 3rd side by law of sines
00				164	ENTER↑		
119	GTO	07	Now there are three sides	165	SIN		
120	*LBL	09		166	R↑		
121	RDN			167	/		
122	XEQ	95	Check third angle	168	ENTER↑		
123	X=0?			169	R↑		
124	GTO	04		170	*		
125	RDN			171	ASIN		
126	X<>Y			172	ENTER↑		
127	R↑			173	R↑		
128	XEQ	06	Find missing side	174	+		
129	XEQ	91		175	X<>Y		
130	STO	IND		176	LASTX		
00				177	-		
131	GTO	07		178	X<=0?		
132	*LBL	05	Law of cosines SAS	179	GTO	09	
133	X<>Y			180	"SOL. 0		Prompt for SSA ambiguous cases
134	P-R			OR 1?"			
135	RCL	Z		181	PROMPT		
136	-			182	CF	22	

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PROGRAM LISTING

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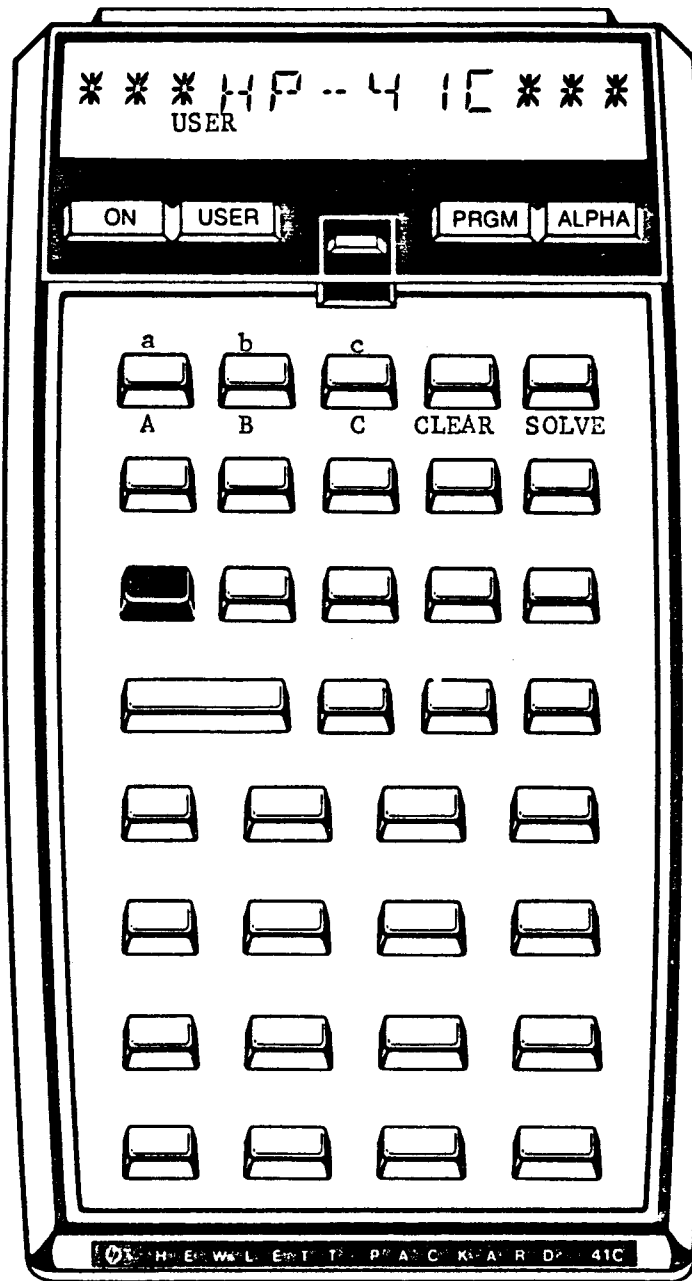
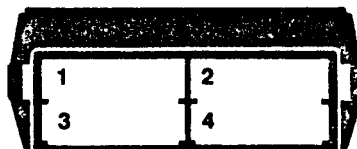
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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS	STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
183	*			228	X<> L		
184	X=0?			229	X<> 00		
185	X<>Y			230	RTN		
186	LBL 09			231	.END.		
187	RDN						
188	SIN						
189	X<>Y						
190	/						
191	RTN						
192	LBL 11			60			
193	XEQ 91		Find third angle given other two				
194	+						
195	LASTX						
196	X<>Y						
197	COS						
198	CHS						
199	ACOS						
200	LBL 12						
201	XEQ 14			70			
202	STO IND		Store angle I				
	L						
203	RTN						
204	LBL 92						
205	XEQ 91		Increment I twice				
206	LBL 91						
207	ISG 00		Increment I				
208	RTN						
209	3						
210	ST- 00			80			
211	RDN						
212	RTN						
213	LBL 93						
214	XEQ 91		Increment I and Recall side I				
215	RCL IND						
	00						
216	RTN						
217	LBL 95						
218	XEQ 91		Increment I and recall angle I				
219	LBL 13			90			
220	XEQ 14						
221	RCL IND						
	L						
222	RTN						
223	LBL 14						
224	X<> 00						
225	3						
226	X<>Y						
227	+			00			

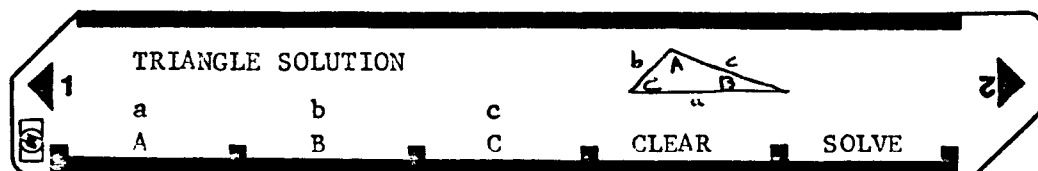
Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

KEYBOARD CARD LABELING

KEYBOARD

SYSTEM
CONFIGURATION

CARD



PROGRAM REGISTERS NEEDED: 57

ROW 1 (1 - 8)



ROW 2 (9 - 16)



ROW 3 (16 - 24)



ROW 4 (25 - 32)



ROW 5 (32 - 38)



ROW 6 (38 - 41)



ROW 7 (41 - 49)



ROW 8 (49 - 56)



ROW 9 (56 - 62)



ROW 10 (62 - 69)



ROW 11 (69 - 76)



ROW 12 (77 - 84)



ROW 13 (84 - 93)



ROW 14 (93 - 100)



ROW 15 (100 - 108)



ROW 16 (109 - 115)



ROW 17 (116 - 122)



ROW 18 (122 - 129)



ROW 19 (129 - 138)



ROW 20 (138 - 144)



ROW 21 (144 - 153)



ROW 22 (154 - 162)



ROW 23 (163 - 175)



ROW 24 (176 - 180)



ROW 25 (180 - 187)



ROW 26 (188 - 198)



ROW 27 (199 - 205)



ROW 28 (206 - 214)



ROW 29 (214 - 220)



ROW 30 (220 - 229)



ROW 31 (229 - 231)



