UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Texas Instruments Model 59 Hand-Calculator Programs to Calculate CIPW Norms

by

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Use of particular manufacturers and model numbers in this report is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.

Although this program has been extensively tested, the U.S. Geological Survey cannot guarantee that it will give correct results in any particular application.

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards.

INTRODUCTION

This package contains two programs to calculate CIPW norms following the technique of H. S. Washington (1917). Program 1 gives a short version of the CIPW norms and is faster (taking about 2 minutes per analysis). To use Program 1, the operator must initially read two program cards into the calculator, and after that, all rock analyses can be run without reading any more cards. Program 2 gives a complete CIPW norm analysis, but it is more cumbersome and slower (taking about 5 minutes per analysis). Program 2 consists of five cards which must be read into the calculator for each separate analysis.

Program 1 uses only the most commonly reported components in a rock chemical analysis: SiO_2 Al_2O_3, Fe_2O_3, FeO, MgO, CaO, Na_2O, K_2O, TiO_2, P_2O_5, MnO, and CO_2, The norm is calculated water free and is adjusted to 100%. Many rock analyses encountered in practice and in literature can be handled by this program. Rocks that are SiO_2 and Al_2O_3 saturated or oversaturated and that contain no excess CO_2 and P_2O_5 can be safely handled by program 1. Program 2 should be used when the rock contains nepheline or other feldspathoids, rutile, sodium pyroboles, melilites, exotic salts or carbonates, or minor amounts of heavy phosphates (monazite, xenotine, etc.).

Both programs are written for use with the Texas Instruments PC-100A printer. If a printer is not available, the program can be modified by replacing all "PRT" statements with a "R/S". The user may then copy the output at his own pace.

PROGRAM 1 = SHORT CIPW NORMS

This program is a translation from an earlier program written for the Hewlett-Packard Model 67/97 calculator by D. H. McIntyre, U.S. Geological Survey (1978, written communication). The Hewlett-Packard program is an abbreviated version of the computer program M0016, "General Rock Norm Analysis" formerly used by the U.S. Geological Survey.

The following abbreviations for the normative minerals are used in Program 1:

q	= normative quartz (SiO_2)
c	= corundum (Al_2O_3)
or	= orthoclase ($KAlSi_3O_8$)
ab	= albite ($NaAlSi_3O_8$)
an	= anorthite ($CaAl_2Si_2O_8$)
cc	= calcite ($CaCO_3$)
ap	= apatite ($Ca_5F(PO_4)_3$)
il	= ilmenite ($FeTiO_3$)
hm	= hematite (Fe_2O_3)
mt	= magnetite (Fe_3O_4)
di	= diopside ($Ca(Mg,Fe)(SiO_3)_2$)
hy	= hypersthene ($(Mg,Fe)SiO_3$)
ol	= olivine ($(Fe,Mg)_2SiO_4$)
ol - fa	= olivine - fayalite (Fe_2SiO_4)

ol - fo = olivine - forsterite (Mg_2SiO_4)
hy - fs = hypersthene - ferrosilite ($FeSiO_3$)
hy - en = hypersthene - enstatite ($MgSiO_3$)
di - fs = diopside - ferrosilite (iron component of diopside)
di - en = diopside - enstatite (magneisum component of diopside)
di - wo = diopside - wollastonite (calcium component of diopside)
wo = wollastonite ($CaSiO_3$)

The program performs the following operations for quartz normative rocks with calculations done in molar amounts:

FeO = FeO + MnO
If FeO $\geq$ TiO_2, then
FeO = FeO - TiO_2,
il = TiO_2.
If FeO < TiO_2 then
TiO_2 = TiO_2 - FeO,
il = FeO, - Excess TiO_2 is not alloted for rutile.
and FeO = 0.
If Fe_2O_3 $\geq$ FeO, then
mt = FeO,
hm = Fe_2O_3 - FeO,
and fs = 0.
If Fe_2O_3 < FeO, then
mt = Fe_2O_3,
fs = FeO - Fe_2O_3,
and hm = 0. - If CaO < $\frac{10}{3}$ P_2O_5 + CO_2 or Al_2O_3 < K_2O + Na_2O, then a negative value for anorthite could occur, and the analysis should be considered invalid.
CaO = CaO - 10/3 P_2O_5 - CO_2
ap = P_2O_5
cc = CO_2
Al_2O_3 = Al_2O_3 - K_2O - Na_2O
or = K_2O
ab = Na_2O
If Al_2O_3 $\geq$ CaO, then
an = CaO,
c = Al_2O_3 - CaO,
and CaO =0
If Al_2O_3 < CaO, then
an = Al_2O_3,
CaO = CaO - Al_2O_3,
Al_2O_3 = 0,
and c = 0.
en = MgO
If CaO $\geq$ (en + fs), then
di = en + fs,
wo = CaO - (en + fs),
hy = 0,
and ol = 0.
If CaO < (en + fs), then
di = CaO,

hy = (en + fs) - CaO,

and wo = 0.

SiO_2 = SiO_2 - 6or - 6ab - 2an - 2di - wol - hy

wo = wo + di

If $SiO_2 \geq 0$, then

q = SiO_2, and skip ahead to *

If $SiO_2 < 0$, then

SiO_2 = SiO_2 + hy.

If 2 $SiO_2 \geq$ hy, then

ol = hy - SiO_2,

hy = 2SiO_2 - hy,

and SiO_2 = 0.

If 2SiO_2 < hy, then

ol = 1/2 hy,

hy = 0,

and SiO_2 = 0.

*R_1 = en/(en + fs)

hy - en = R_1 x hy

di - en = R_1 x di

ol - fo = R_1 x ol

ol - fa = ol(-)ol - fo

R_2 = fs/(en + fs)

hy - fs = R_2 x hy

di - fs R_2 x di

di-wo = di

To prepare program cards:

1. Set partitioning at 559.49 (5 op 17).
2. With calculator in LRN mode, key in <u>all</u> program steps.
3. Exit from LRN mode.
4. Store the following constants in the registers as shown:

MOLECULAR WEIGHT OF:	VALUE	REGISTER
	0.	00
	0.	01
	0.	02
	0.	03
	0.	04
	0.	05
	0.	06
	0.	07
	0.	08
	0.	09
	0.	10
	0.	11
	0.	12
	0.	13
	0.	14
	0.	15
	0.	16
	0.	17
	0.	18
	0.	19
	0.	20
SiO_2	60.0848	21
Al_2O_3	101.9612	22
Fe_2O_3	159.6922	23
FeO	71.8464	24

MOLECULAR WEIGHT OF:	VALUE	REGISTER
MgO	40.3144	25
CaO	56.0794	26
Na_2O	61.979	27
K_2O	94.2034	28
TiO_2	79.8988	29
P_2O_5	141.9446	30
MnO	70.9734	31
CO_2	44.01	32
fs	131.9312	33
en	100.3962	34
fa	203.7779	35
fo	140.7076	36
fs	131.9312	37
en	100.3962	38
wo	116.1642	39
cc	100.0894	40
ap	336.2084	41
il	151.7449	42
hm	159.6922	43
mt	231.5386	44
c	101.9612	45
an	278.2102	46
ab	524.449	47
or	556.6734	48
q	60.0843	49

5. Press "1" "2nd" Write" and feed in side 1 of card 1. Press "2" "2nd" "Write" and feed in side 2 of card 1. Press "3" "2nd" "Write" and feed in side 1 of card 2. Press "4" "2nd" "Write" and feed in side 2 of card 2.

TITLE SHORT CIPW NORMS PAGE 5 OF _____ TI Programmable **Program Record**

PROGRAMMER RANDALL LEE MACKIE DATE _____

Partitioning (Op 17) [ ] Library Module _____ Printer _____ Cards _____

USER INSTRUCTIONS

STEP	PROCEDURE	ENTER	PRESS			DISPLAY
1	REPARTITION	5	2nd	op	17	559.49
2	LOAD SIDE 1 AND SIDE 2 OF CARD 1					
3	LOAD SIDE 1 AND SIDE 2 OF CARD 2					
4	SET PROGRAM FOR NEW ANALYSIS				A	1
5	ENTER ROCK ANALYSIS (wt. %)	% SiO_2	B	or	R/S	2
		% Al_2O_3	B	or	R/S	3
	NOTE: IF MgO = 0,	% Fe_2O_3	B	or	R/S	4
	SUBSTITUTE AN INFINITESMAL	% Fe O	B	or	R/S	5
	SMALL VALUE OR AN ERROR	% MgO	B	or	R/S	6
	WILL RESULT IN THE	% CaO	B	or	R/S	7
	CALCULATIONS.	% Na_2O	B	or	R/S	8
		% K_2O	B	or	R/S	9
		% TiO_2	B	or	R/S	10
		% P_2O_5	B	or	R/S	11
		% MnO	B	or	R/S	12
		% CO_2	B	or	R/S	13
6	IF AN ERRONEOUS VALUE IS ENTERED DURING STEP 5, PRESS "E" (ERROR) SUCCESSIVELY TO GO BACK TO THE ERRONEOUS VALUE. EACH TIME "E" IS PRESSED, THE LAST VALUE WILL BE PRINTED WITH A QUESTION MARK. WHEN THE ERRONEOUS VALUE IS REACHED, PROCEED AS USUAL FROM THAT POINT (ILLUSTRATED IN EXAMPLE).					
7	CHECK THE PRINT-OUT OF ENTERED VALUES TO MAKE SURE ALL ARE CORRECT. IF AN ERRONEOUS VALUE WAS ENTERED, GO TO STEP 6. OTHERWISE, PRESS "C" TO CONTINUE.					

USER INSTRUCTIONS

STEP	PROCEDURE	ENTER	PRESS			DISPLAY
	THE PRINT-OUT WILL CONSIST OF:					
	A) THE INPUT DATA, IN THE SAME ORDER,					
	ADJUSTED TO 100%.					
	B) THE NORMATIVE MINERALS					q
	(wt. %) IN THE ORDER					or
	AS SHOWN.					ab
						an
	NOTE: Should a negative value for anorthite					c
	occur, the CIPW analysis should be					mt
	~~considered invalid. This might~~					hm
	result from any of the following:					
	deficiency of CaO or Al_2O_3, or an					il
	~~excess of P_2O_5, CO_2, K_2O, or Na_2O.~~					ap
						cc
						wol
						hy-en
						hy-fs
						ol-fo
						ol-fa
						di-en
						di-fs
						di-wol
8	FOR A NEW ANALYSIS, GO TO STEP 4.					
	WARNING: DO NOT CLEAR DATA MEMORY					
	REGISTERS AS MOLECULAR WEIGHTS ARE					
	STORED IN REGISTERS 21-49.					

TITLE PROGRAM 1 PAGE 7 OF

PROGRAMMER DATE

TI Programmable **Coding Form**

LOC	CODE	KEY	COMMENTS
000	76	LBL	
001	11	A	PRIME PROGRAM
002	01	1	
003	42	STO	
004	00	00	
005	00	0	
006	42	STO	
007	13	13	
008	76	LBL	
009	91	R/S	
010	43	RCL	INPUT AND STORE %'s
011	00	00	
012	91	R/S	
013	76	LBL	
014	12	B	
015	99	PRT	
016	72	ST*	
017	00	00	
018	44	SUM	
019	13	13	
020	69	OP	
021	20	20	
022	01	1	
023	03	3	
024	32	X:T	
025	43	RCL	
026	00	00	
027	67	EQ	
028	52	EE	
029	61	GTO	
030	91	R/S	
031	76	LBL	
032	15	E	ERROR RECOVERY
033	07	7	
034	01	1	
035	69	OP	
036	04	04	
037	69	OP	
038	30	30	
039	73	RC*	
040	00	00	
041	69	OP	
042	06	06	
043	22	INV	
044	44	SUM	
045	13	13	
046	61	GTO	
047	91	R/S	
048	76	LBL	
049	52	EE	
050	91	R/S	
051	76	LBL	
052	13	C	
053	98	ADV	
054	01	1	
055	02	2	
056	42	STO	
057	00	00	
058	01	1	
059	00	0	
060	00	0	
061	22	INV	
062	49	PRD	
063	13	13	
064	76	LBL	ADJUST %'s
065	34	FX	
066	73	RC*	
067	00	00	
068	55	÷	
069	43	RCL	
070	13	13	
071	95	=	PRINT AND RESTORE NEW VALUES
072	72	ST*	
073	00	00	
074	97	DSZ	
075	00	00	
076	34	FX	
077	58	FIX	
078	02	02	
079	01	1	
080	42	STO	
081	00	00	
082	76	LBL	
083	37	P/R	
084	73	RC*	
085	00	00	
086	99	PRT	
087	69	OP	
088	20	20	
089	43	RCL	
090	00	00	
091	32	X:T	
092	01	1	
093	03	3	
094	22	INV	
095	67	EQ	
096	37	P/R	
097	01	1	
098	02	2	
099	42	STO	
100	00	00	
101	03	3	
102	02	2	
103	42	STO	
104	20	20	
105	76	LBL	
106	55	÷	
107	73	RC*	
108	00	00	
109	55	÷	
110	73	RC*	
111	20	20	
112	95	=	
113	72	ST*	
114	00	00	
115	01	1	
116	22	INV	
117	44	SUM	
118	20	20	
119	97	DSZ	
120	00	00	
121	55	÷	
122	43	RCL	FeO
123	04	04	
124	85	+	
125	43	RCL	MnO
126	11	11	
127	95	=	
128	42	STO	New FeO
129	04	04	
130	32	X:T	
131	43	RCL	TiO_2
132	09	09	
133	22	INV	
134	77	GE	FeO > TiO_2 ?
135	77	GE	
136	00	0	
137	48	EXC	
138	04	04	
139	42	STO	
140	13	13	
141	00	0	
142	61	GTO	
143	49	PRD	
144	76	LBL	
145	77	GE	
146	42	STO	
147	13	13	i1
148	32	X:T	
149	75	-	
150	32	X:T	
151	95	=	
152	42	STO	New FeO
153	04	04	
154	76	LBL	
155	49	PRD	
156	32	X:T	

MERGED CODES

62 [inv] [inv]	72 [STO] [inv]	83 [GTO] [inv]
63 [inv] [inv]	73 [RCL] [inv]	84 [inv] [inv]
64 [inv] [inv]	74 [SUM] [inv]	92 [INV] [SBR]

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TITLE PROGRAM 1 PAGE 8 OF

PROGRAMMER DATE

TI Programmable Coding Form

LOC	CODE	KEY	COMMENTS
157	43	RCL	
158	03	03	
159	77	GE	$Fe_2O_3 \geq$ FeO?
160	85	+	
161	42	STO	
162	15	15	mt
163	32	X↕T	
164	75	-	
165	32	X↕T	
166	95	=	
167	42	STO	
168	20	20	fs
169	00	0	
170	42	STO	
171	14	14	hm = 0
172	61	GTO	
173	75	-	
174	76	LBL	
175	85	+	
176	32	X↕T	
177	42	STO	
178	15	15	mt
179	32	X↕T	
180	75	-	
181	32	X↕T	
182	95	=	
183	42	STO	
184	14	14	hm
185	00	0	
186	42	STO	fs = 0
187	20	20	
188	76	LBL	
189	75	-	
190	43	RCL	
191	10	10	P_2O_5
192	65	×	
193	01	1	
194	00	0	
195	55	÷	
196	03	3	
197	95	=	
198	94	+/-	
199	85	+	
200	43	RCL	
201	06	06	CaO
202	75	-	
203	43	RCL	
204	12	12	CO_2
205	95	=	
206	42	STO	new
207	06	06	CaO
208	43	RCL	
209	15	15	
210	42	STO	

LOC	CODE	KEY	COMMENTS
211	11	11	
212	43	RCL	REGISTER
213	10	10	SWAPPING
214	48	EXC	TO
215	08	08	ARRANGE
216	42	STO	OUTPUT
217	15	15	ORDER
218	43	RCL	
219	07	07	
220	48	EXC	
221	12	12	
222	42	STO	
223	07	07	
224	43	RCL	
225	14	14	
226	42	STO	
227	10	10	
228	43	RCL	
229	12	12	
230	42	STO	
231	14	14	
232	43	RCL	
233	13	13	
234	42	STO	
235	09	09	
236	43	RCL	
237	02	02	Al_2O_3
238	75	-	
239	43	RCL	
240	14	14	Na_2O
241	75	-	
242	43	RCL	
243	15	15	K_2O
244	95	=	
245	42	STO	new
246	02	02	Al_2O_3
247	32	X↕T	
248	43	RCL	
249	06	06	CaO
250	22	INV	
251	77	GE	$Al_2O_3 >$ CaO?
252	33	X^2	
253	32	X↕T	
254	42	STO	
255	13	13	an
256	32	X↕T	
257	75	-	
258	32	X↕T	
259	95	=	
260	42	STO	New
261	06	06	CaO
262	00	0	
263	42	STO	
264	12	12	

LOC	CODE	KEY	COMMENTS
265	42	STO	
266	02	02	
267	61	GTO	
268	35	1/X	
269	76	LBL	
270	33	X^2	
271	42	STO	
272	13	13	an
273	32	X↕T	
274	75	-	
275	32	X↕T	
276	95	=	
277	42	STO	
278	12	12	c
279	00	0	
280	42	STO	
281	06	06	
282	76	LBL	
283	35	1/X	
284	43	RCL	
285	05	05	en (MgO)
286	85	+	
287	43	RCL	
288	20	20	fs
289	95	=	
290	42	STO	
291	00	00	en+fs
292	32	X↕T	
293	43	RCL	
294	06	06	CaO
295	77	GE	CaO ≥ (en+fs)?
296	38	SIN	
297	42	STO	
298	18	18	di
299	32	X↕T	
300	75	-	
301	32	X↕T	
302	95	=	
303	42	STO	
304	19	19	hy
305	43	RCL	
306	00	00	en+fs
307	35	1/X	
308	65	×	
309	43	RCL	
310	05	05	en
311	95	=	
312	42	STO	
313	17	17	R_1

MERGED CODES

62 [inv] [inv]	72 [STO] [inv]	83 [GTO] [inv]
63 [inv] [inv]	73 [RCL] [inv]	84 [inv] [inv]
64 [inv] [inv]	74 [SUM] [inv]	92 [INV] [SBR]

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TITLE PROGRAM 1 PAGE 9 OF

PROGRAMMER DATE

TI Programmable **Coding Form**

LOC	CODE	KEY	COMMENTS
314	00	0	
315	42	STO	wo = 0
316	16	16	
317	61	GTO	
318	23	LNX	
319	76	LBL	
320	38	SIN	
321	32	X:T	
322	42	STO	
323	18	18	di
324	43	RCL	
325	05	05	en
326	55	÷	
327	43	RCL	
328	00	00	en+fs
329	95	=	
330	42	STO	
331	17	17	R_1
332	43	RCL	
333	06	06	CaO
334	75	-	
335	43	RCL	
336	18	18	di
337	95	=	
338	42	STO	
339	16	16	wo
340	00	0	
341	42	STO	hy = 0
342	19	19	
343	76	LBL	
344	23	LNX	
345	43	RCL	
346	01	01	SiO_2
347	75	-	
348	06	6	
349	65	×	
350	43	RCL	
351	15	15	or
352	75	-	
353	06	6	
354	65	×	
355	43	RCL	
356	14	14	ab
357	75	-	
358	02	2	
359	65	×	
360	43	RCL	
361	13	13	an
362	75	-	
363	02	2	
364	65	×	
365	43	RCL	
366	18	18	di
367	75	-	
368	43	RCL	
369	16	16	wo
370	75	-	
371	43	RCL	
372	19	19	hy
373	95	=	
374	42	STO	New SiO_2
375	01	01	
376	32	X:T	
377	00	0	
378	42	STO	ol = 0
379	04	04	
380	32	X:T	$SiO_2 \geq$ 0?
381	77	GE	
382	45	Y×	
383	85	+	
384	43	RCL	
385	19	19	hy
386	95	=	
387	42	STO	
388	01	01	SiO_2
389	65	×	
390	02	2	
391	95	=	
392	32	X:T	
393	43	RCL	
394	19	19	hy
395	32	X:T	$2\,SiO_2 \geq$ hy?
396	77	GE	
397	30	TAN	
398	32	X:T	
399	55	÷	
400	02	2	
401	95	=	
402	42	STO	
403	04	04	ol
404	00	0	
405	42	STO	
406	19	19	hy = 0
407	42	STO	
408	01	01	$SiO_2 = 0$
409	61	GTO	
410	45	Y×	
411	76	LBL	
412	30	TAN	
413	32	X:T	
414	75	-	
415	43	RCL	
416	01	01	SiO_2
417	95	=	
418	42	STO	
419	04	04	ol
420	43	RCL	
421	19	19	hy
422	94	+/-	
423	85	+	
424	02	2	
425	65	×	
426	43	RCL	
427	01	01	SiO_2
428	95	=	
429	42	STO	
430	19	19	hy
431	00	0	
432	42	STO	
433	01	01	$SiO_2 = 0$
434	76	LBL	
435	45	Y×	
436	43	RCL	REGISTER SWAPPING
437	16	16	
438	42	STO	
439	06	06	
440	43	RCL	
441	01	01	
442	42	STO	
443	16	16	
444	43	RCL	
445	17	17	R_1
446	65	×	
447	43	RCL	
448	19	19	hy
449	95	=	
450	42	STO	
451	05	05	hy-en
452	43	RCL	
453	17	17	R_1
454	65	×	
455	43	RCL	
456	18	18	di
457	95	=	
458	42	STO	
459	01	01	di-en
460	43	RCL	
461	17	17	R_1
462	65	×	
463	43	RCL	
464	04	04	ol
465	95	=	
466	42	STO	
467	03	03	ol-fo
468	43	RCL	
469	04	04	ol
470	75	-	

MERGED CODES

62 [INC] [INC]		72 [STO] [INC]		83 [GTO] [INC]	
63 [INC] [INC]		73 [RCL] [INC]		84 [INC] [INC]	
64 [INC] [INC]		74 [SUM] [INC]		92 [INV] [SBR]	

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TI-24151

TITLE PROGRAM 1 PAGE 10 OF _____

PROGRAMMER _____ DATE _____

TI Programmable **Coding Form**

LOC	CODE	KEY	COMMENTS
471	43	RCL	
472	03	03	o1-fo
473	95	=	
474	42	STO	
475	02	02	o1-fa
476	43	RCL	
477	00	00	en+fs
478	35	1/X	
479	65	×	
480	43	RCL	
481	20	20	fs
482	95	=	
483	42	STO	
484	17	17	R_2
485	65	×	
486	43	RCL	
487	19	19	hy
488	95	=	
489	42	STO	
490	04	04	hy-fs
491	43	RCL	
492	17	17	R_2
493	65	×	
494	43	RCL	di
495	18	18	
496	95	=	
497	42	STO	
498	00	00	di-fs
499	98	ADV	
500	98	ADV	
501	01	1	
502	06	6	
503	42	STO	
504	20	20	
505	43	RCL	
506	06	06	wo
507	85	+	
508	43	RCL	
509	18	18	di-wo
510	95	=	
511	42	STO	
512	06	06	wo
513	76	LBL	
514	70	RAD	
515	73	RC*	
516	20	20	
517	48	EXC	
518	20	20	
519	85	+	
520	03	3	
521	03	3	
522	95	=	
523	48	EXC	
524	20	20	

LOC	CODE	KEY	COMMENTS
525	65	×	PRINT
526	73	RC*	VALUES
527	20	20	FOR
528	95	=	FOLLOWING
529	99	PRT	SPECIES:
530	43	RCL	
531	20	20	or
532	75	-	ab
533	03	3	an
534	04	4	c
535	95	=	mt
536	42	STO	hm
537	20	20	il
538	32	X:T	ap
539	01	1	cc
540	94	+/-	wo
541	22	INV	hy-en
542	67	EQ	hy-fs
543	70	RAD	o1-fo
544	43	RCL	o1-fa
545	39	39	di-en
546	65	×	di-fs
547	43	RCL	di-wo
548	18	18	
549	95	=	
550	99	PRT	
551	92	RTN	

LOC	CODE	KEY	COMMENTS

MERGED CODES

62 [INV] [SBR]	72 [STO] [INV]	83 [GTO] [INV]
63 [INV] [SBR]	73 [RCL] [INV]	84 [INV] [SBR]
64 [INV] [SBR]	74 [SUM] [INV]	92 [INV] [SBR]

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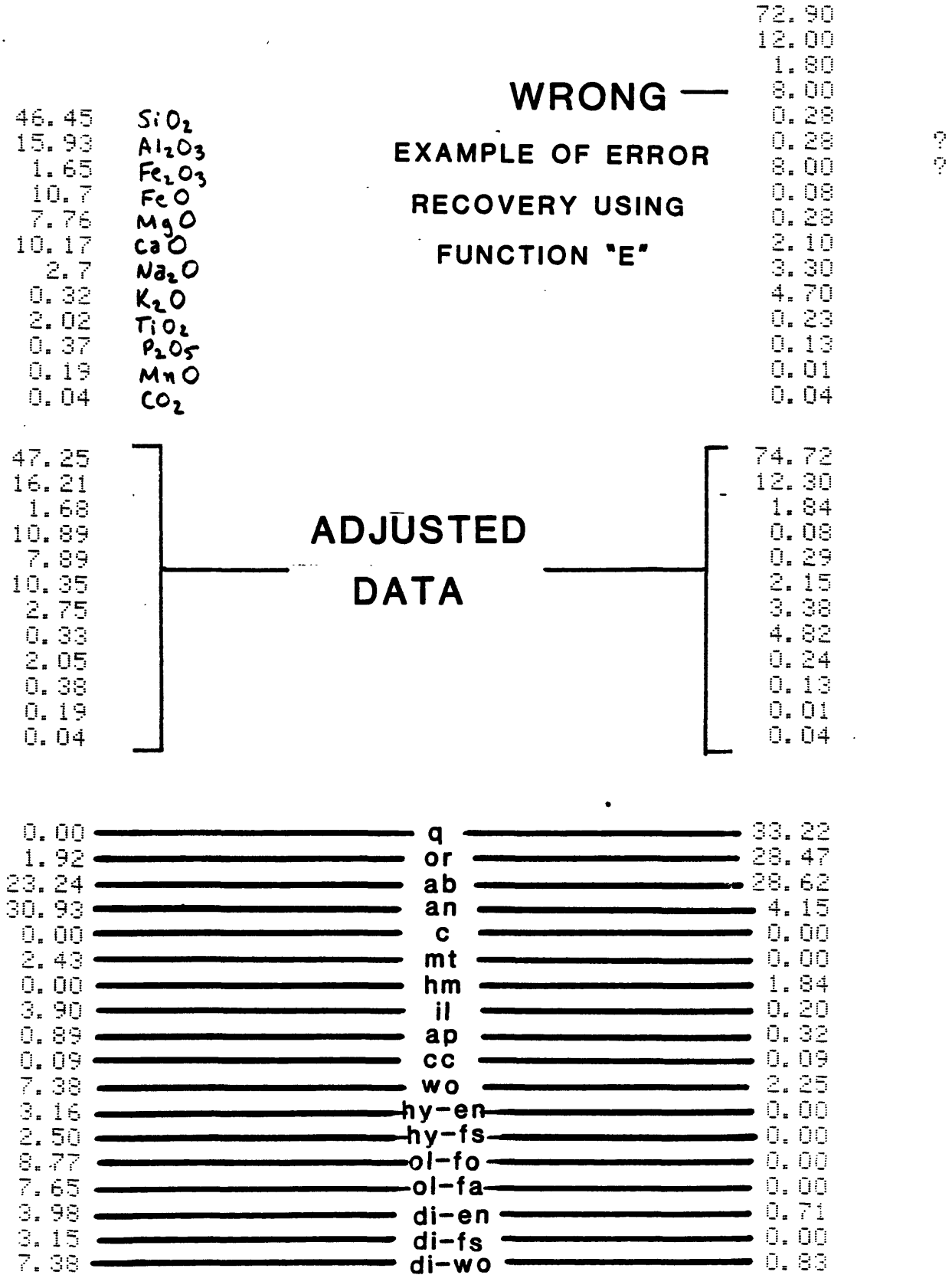
EXAMPLES:


WRONG —
EXAMPLE OF ERROR
RECOVERY USING
FUNCTION "E"
ADJUSTED
DATA
46.45 SiO2
15.93 Al2O3
1.65 Fe2O3
10.7 FeO
7.76 MgO
10.17 CaO
2.7 Na2O
0.32 K2O
2.02 TiO2
0.37 P2O5
0.19 MnO
0.04 CO2
72.90
12.00
1.80
8.00
0.28
0.28 ?
8.00 ?
0.08
0.28
2.10
3.30
4.70
0.23
0.13
0.01
0.04
47.25
16.21
1.68
10.89
7.89
10.35
2.75
0.33
2.05
0.38
0.19
0.04
74.72
12.30
1.84
0.08
0.29
2.15
3.38
4.82
0.24
0.13
0.01
0.04
0.00 q 33.22
1.92 or 28.47
23.24 ab 28.62
30.93 an 4.15
0.00 c 0.00
2.43 mt 0.00
0.00 hm 1.84
3.90 il 0.20
0.89 ap 0.32
0.09 cc 0.09
7.38 wo 2.25
3.16 hy-en 0.00
2.50 hy-fs 0.00
8.77 ol-fo 0.00
7.65 ol-fa 0.00
3.98 di-en 0.71
3.15 di-fs 0.00
7.38 di-wo 0.83

PROGRAM 2 = COMPLETE CIPW NORMS

This program calculates CIPW Norms for most rocks. Five cards must be used to run each analysis; however, the program's advantage is that it gives a complete CIPW norm analysis. The technique used follows that of H. S. Washington (1917). This program is a translation of portions of the FORTRAN subroutine NORM written by Bower (1971) and modified by Stuckless and VanTrump (1979). This program does not adjust the totals for excess O_2; also, the weight percent water entered is used for adjusting the data and does not enter into the calculatons. The examples given at the end of this documentation for testing the program are from Stuckless and VanTrump (1979). This program has been found to give results comparable to those of Stuckless and VanTrump (1979) except for high halide samples, which were not adjusted by this program for excess O_2.

REFERENCES

Bowen, R. W., 1971, Graphic normative analysis program: U.S. Geol. Survey Computer Contriubtion No. 13, 80p.

Stuckless, J. S., VanTrump, G., 1979, A revised version of graphic normative analysis program (GNAP) with examples of petrological problem solving, U.S. Geological Survey Open-File Report 79-1237, 112 p.

Washington, H. S., 1917, Chemical analyses of igneous rocks: U.S. Geological Survey Professional Paper 99, 1201 p.

The following abbreviations are used in Program 2:

q = quartz (SiO_2)
c = corundum (Al_2O_3)
z = zircon ($ZrSiO_4$)
or = orthoclase ($KAlSi_3O_8$)
ab = albite ($NaAlSi_3O_8$)
an = anorthite ($CaAl_2Si_2O_8$)
lc = leucite ($K_2Al_2Si_4O_{12}$)
ne = nepheline ($Na_2Al_2Si_2O_8$)
kp = kaliophilite ($K_2Al_2Si_2O_8$)
hl = halite ($NaCl$)
th = thenardite (Na_2SO_4)
ac = acmite ($Na_2Fe_2Si_4O_{12}$)
ns = sodium metasilicate (Na_2SiO_3)
ks = potassium metasilicate (K_2SiO_3)
fr = fluorite (CaF_2)
pr = pyrite (FeS_2)
cc = calcite ($CaCO_3$)
mg = magnesite ($MgCO_3$)
wo = wollastonite ($CaSio_3$)
en = enstatite ($MgSiO_3$)
fs = ferrosilite ($FeSiO_3$)
fo = forsterite (Mg_2SiO_4)
fa = fayalite (Fe_2SiO_4)
cs = calcium orthosiliate (Ca_2SiO_4)
mt = magnetite (Fe_3O_4)
cm = chromite ($FeCr_2O_4$)
hm = hematite (Fe_2O_3)
il = ilmenite ($FeTiO_3$)
tn = titanite-sphene ($CaTiSiO_5$)
pf = perovskite ($CaTiO_3$)
ru = rutile (TiO_2)
ap = apatite ($Ca_5F(PO_4)_3$)
sd = siderite ($FeCO_3$)
di = diopside (en+fs+wo-wol)
hy = hypersthlene (en+fs)
ol = olivine (fo+fa)

The variable names for partitioning of normative clinopyroxene, orthopyroxene, and olivine are as follows:

di = diopside ($Ca(Fe,Mg)(SiO_3)_2$)
di-wo = calcium component of diopside
di-en = magnesium component of diopside
di-fs = iron component of diopside
wol = excess calcium clinopyroxene beyond that needed for diopside
hy = hypersthene (Mg, Fe) SiO_3
hy-en = magnesium component of hypersthene
hy-fs = iron component of hypersthene
ol = olivine $(Fe,Mg)_2SiO_4$
ol-fo = magnesium component of olivine
ol-fa = iron component of olivine

To prepare program card set 2:

1. Set partitioning at 479.59 (6 op 17).
2. With calculator in LRN mode, key in all program steps for card set 2 only.
3. Exit from LRN mode.
4. Press "1 2nd Write" and feed in side 1 of the card. Press "2 2nd Write" and feed in side 2 of the card.

To prepare program card set 3:

1. Set partitioning at 479.59 (6 op 17).
2. With calculator in LRN mode, key in all program steps for card set 3 only.
3. Exit from LRN mode.
4. Press "1 2nd Write" and feed in side 1 of the card. Press "2 2nd Write" and feed in side 2 of the card.

To prepare program card set 1:

1. Set partitioning at 479.59 (6 op 17).
2. With calculator in LRN mode, key in all program steps for card set 1 only.
3. Exit from LRN mode
4. Store the following constants in the registers as shown:

MOLECULAR WEIGHT OF:	VALUE	REGISTER
	0.	00
	0.	01
	0.	02
	0.	03
	0.	04
	0.	05
	0.	06
	0.	07
	0.	08
	0.	09
	0.	10
	0.	11
	0.	12
	0.	13
	0.	14
	0.	15
	0.	16
	0.	17
	0.	18
	0.	19
	0.	20
	0.	21
	0.	22
	0.	23
SiO_2	60.0848	24
Al_2O_3	101.9612	25

VALUE		REGISTER
Fe_2O_3	159.6922	26
FeO	71.8464	27
MgO	40.3144	28
CaO	56.0794	29
Na_2O	61.979	30
K_2O	94.2034	31
H_2O	18.01534	32
TiO_2	79.8988	33
P_2O_5	141.9446	34
MnO	70.9734	35
ZrO_2	123.2187953	36
CO_2	44.01	37
SO_3	80.06219231	38
Cl	35.45299713	39
F	18.99840052	40
S	32.06400488	41
Cr_2O_3	151.9901899	42
NiO	74.70938051	43
BaO	153.3394025	44
	0.	45
	0.	46
	0.	47
	0.	48
	0.	49
	0.	50

5. Press "1 2nd Write" and feed in side 1 of card 1. Press "2 2nd Write" and feed in side 2 of card 1. Press "3 2nd Write" and feed in side 1 of card 2. Pres "4 2nd Write" and feed in side 2 of card 2.

To prepare program card set 4:

1. Set partitioning at 159.99 (10 op 17).

2. With calculator in LRN mode, key in all program steps for card set 4 only.

3. Exit from LRN mode.

4. Store the following constants in the registers as shown:

MOLECULAR WEIGHT OF:	VALUE	REGISTER
	0.	33
	0.	34
	0.	35
	0.	36
	0.	37
	0.	38
	0.	39
	0.	40
	0.	41
	0.	42
	0.	43
	0.	44
	0.	45
	0.	46
	0.	47
	0.	48
	0.	49
	0.	50
	0.	51
	0.	52
	0.	53
	0.	54
	0.	55
	0.	56
	0.	57
	0.	58
	0.	59
q	60.0843	60
c	101.9612	61
z	183.3036	62
or	556.6734	63
ab	524.449	64
an	278.2102	65
lc	436.5038	66
ne	284.1098	67
kp	316.3342	68
hl	116.8856	69
th	142.0412	70
ac	462.0104	71
ns	122.0638	72
ks	154.2882	73
wo	116.1642	74
en	100.3962	75
fs	131.9312	76
fo	140.7076	77
fa	203.7779	78
cs	172.2436	79
mt	231.5386	80
cm	223.8363	81
hm	159.6922	82
il	151.7449	83
tn	196.063	84
pf	135.9782	85
ru	79.8988	86
ap	336.2084	87
fr	78.0768	88
pr	119.975	89
cc	100.0894	90
mg	84.32135	91
sd	115.8564	92
ol-fa	203.7779	93
ol-fo	140.7076	94
hy-fs	131.9312	95
hy-en	100.3962	96
di-fs	131.9312	97
di-en	100.3962	98
di-wo	116.1642	99

5. Press "1 2nd Write" and feed in side 1 of the card. Press "2 2nd Write" and feed in side 2 of the card.

TITLE _____ PAGE 16 OF _____

PROGRAMMER Randall Lee Mackie DATE _____

11 Programmable **Program Record**

Partitioning (Op 17) [ ] Library Module _____ Printer _____ Cards _____

USER INSTRUCTIONS

STEP	PROCEDURE	ENTER	PRESS			DISPLAY
1	Load side 1 and side 2 of card 1, card					
	set 1.					
2	Load side 1 and side 2 of card 2, card					
	set 1.					
3	Set program for new analysis				A	1
4	Enter rock analysis (wt. %).	SiO_2	B	or	R/S	2
		Al_2O_3	B	or	R/S	3
		Fe_2O_3	B	or	R/S	4
		FeO	B	or	R/S	5
		MgO	B	or	R/S	6
		CaO	B	or	R/S	7
		Na_2O	B	or	R/S	8
	NOTE: If MgO = 0, substitute	K_2O	B	or	R/S	9
	an infinitesmal small value or an	H_2O	B	or	R/S	10
	error will result in the	TiO_2	B	or	R/S	11
	calculations.	P_2O_5	B	or	R/S	12
		MnO	B	or	R/S	13
		ZrO_2	B	or	R/S	14
		CO_2	B	or	R/S	15
		SO_3	B	or	R/S	16
		Cl	B	or	R/S	17
		F	B	or	R/S	18
		S	B	or	R/S	19
		Cr_2O_3	B	or	R/S	20
		NiO	B	or	R/S	21
		BaO	B	or	R/S	22
5	If an erroneous value is entered during step 5, press "E" (Error)					
	successively to go back to the erroneous value. Each time "E" is					
	pressed, the last value will be printed with a question mark.					
	When the erroneous value is reached, proceed as usual from that					
	point (illustrated in example).					

PROGRAMMER Randall Lee Mackie DATE _____

TI Programmable **Program Record**

Partitioning (Op 17) [ ] Library Module _____ Printer _____ Cards _____

USER INSTRUCTIONS

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
6	Check the print-out of entered values to make sure all are correct. If an erroneous value was entered, go to step 5. Otherwise, press "C" to continue. A print-out of the input data normalized to 100% will then follow.			
7	When calculations for card set 1 are finished, a "2" will appear in the display. Load side 1 and side 2 of card set 2. Press "C" to continue.			
8	When calculations for card set 2 are finished, note whether a "3" or a "9" appears in the display. Load side 1 and side 2 of card set 3. If the display showed a "3", press "C" to continue. If the display showed a "9", press "E" to continue. This step shifts the program flow depending on whether the rock has a silica deficiency.			
9	When calculations for card set 3 are finished, a "4" will appear in the display. Repartition the calculator to 10 2nd Op 17 (159.99), then load side 1 and side 2 of card set 4, press "C" to continue.			
10	The normative minerals (wt. %) are printed in the following order:			

1.	q	12.	ac	23.	hm	34.	ol-fa		
2.	c	13.	ns	24.	il	35.	ol-fo		
3.	z	14.	ks	25.	tn	36.	hy-fs		
4.	or	15.	wo	26.	pf	37.	hy-en		
5.	ab	16.	en	27.	ru	38.	di-fs		
6.	an	17.	fs	28.	ap	39.	di-en		
7.	lc	18.	fo	29.	fr	40.	di-wo		
8.	ne	19.	fa	30.	pr	41.	di		
9.	kp	20.	cs	31.	cc	42.	hy		
10.	hl	21.	mt	32.	mg	43.	ol		
11.	th	22.	cm	33.	sd	44.	wol		

USER INSTRUCTIONS

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
11	For a new analysis, turn the calculator off and then on, and go to step 1.			
12	As the program is written, the print-out at step 10 keeps two significant figures after the decimal point. To alter this print-out format, the user can change the "FIX 02" statement at steps 03 and 04 of Card Set 3 as desired.			
	NOTE: Should a negative value for anorthite occur, the CIPW analysis should be considered invalid. This might result from any of the following: deficiency of CaO or Al_2O_3, or an excess of P_2O_5, CO_2, K_2O, or Na_2O.			

TITLE PROGRAM 2, CARD SET 1 PAGE 19 OF _____

PROGRAMMER _____ DATE _____

TI Programmable **Coding Form**

LOC	CODE	KEY	COMMENTS
000	76	LBL	
001	11	A	
002	01	1	PRIME
003	42	STO	PROGRAM
004	00	00	
005	00	0	
006	42	STO	
007	22	22	
008	76	LBL	
009	91	R/S	
010	43	RCL	
011	00	00	INPUT
012	91	R/S	AND
013	76	LBL	STORE
014	12	B	% 'S
015	99	PRT	
016	72	ST*	
017	00	00	
018	44	SUM	
019	22	22	
020	69	OP	
021	20	20	
022	02	2	
023	02	2	
024	32	X:T	
025	43	RCL	
026	00	00	
027	67	EQ	
028	52	EE	
029	61	GTO	
030	91	R/S	
031	76	LBL	
032	15	E	
033	07	7	ERROR
034	01	1	RECOVERY
035	69	OP	
036	04	04	
037	69	OP	
038	30	30	
039	73	RC*	
040	00	00	
041	69	OP	
042	06	06	
043	22	INV	
044	44	SUM	
045	22	22	
046	61	GTO	
047	91	R/S	
048	76	LBL	
049	52	EE	
050	91	R/S	
051	76	LBL	
052	13	C	
053	98	ADV	
054	02	2	
055	01	1	
056	42	STO	
057	00	00	
058	01	1	
059	00	0	
060	00	0	
061	22	INV	
062	49	PRD	
063	22	22	
064	76	LBL	
065	34	FX	
066	73	RC*	
067	00	00	
068	55	÷	NORMALIZE
069	43	RCL	% 'S
070	22	22	
071	95	=	
072	72	ST*	
073	00	00	PRINT
074	97	DSZ	AND
075	00	00	RESTORE
076	34	FX	NEW
077	01	1	VALUES
078	42	STO	
079	00	00	
080	58	FIX	
081	02	02	
082	76	LBL	
083	37	P/R	
084	73	RC*	
085	00	00	
086	99	PRT	
087	69	OP	
088	20	20	
089	43	RCL	
090	00	00	
091	32	X:T	
092	02	2	
093	02	2	
094	22	INV	
095	67	EQ	
096	37	P/R	
097	02	2	
098	01	1	
099	42	STO	
100	00	00	
101	04	4	
102	04	4	
103	42	STO	
104	23	23	
105	76	LBL	
106	55	÷	
107	73	RC*	
108	00	00	
109	55	÷	
110	73	RC*	
111	23	23	
112	95	=	
113	72	ST*	
114	00	00	
115	00	0	
116	72	ST*	
117	23	23	
118	01	1	
119	22	INV	
120	44	SUM	
121	23	23	
122	97	DSZ	
123	00	00	
124	55	÷	
125	43	RCL	
126	12	12	
127	85	+	CALCULATE
128	43	RCL	APATITE
129	20	20	
130	95	=	
131	44	SUM	
132	04	04	
133	00	0	
134	32	X:T	
135	43	RCL	
136	21	21	
137	85	+	
138	43	RCL	
139	06	06	
140	75	-	
141	01	1	
142	00	0	
143	55	÷	
144	03	3	
145	65	×	
146	43	RCL	
147	11	11	
148	95	=	
149	42	STO	
150	06	06	
151	77	GE	
152	65	×	
153	65	×	
154	03	3	
155	55	÷	
156	01	1	

MERGED CODES

62 [LBL] [LBL]	72 [STO] [LBL]	83 [GTO] [LBL]
63 [EE] [LBL]	73 [RCL] [EE]	84 [EE] [EE]
64 [EE] [LBL]	74 [SUM] [EE]	92 [INV] [SBR]

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TITLE PROGRAM 2, CARD SET 1 PAGE 20 OF _____

PROGRAMMER _____ DATE _____

TI Programmable **Coding Form**

LOC	CODE	KEY	COMMENTS
157	00	0	
158	95	=	
159	44	SUM	
160	11	11	
161	00	0	
162	42	STO	
163	06	06	
164	76	LBL	
165	65	×	
166	43	RCL	
167	11	11	
168	42	STO	
169	28	28	
170	43	RCL	
171	07	07	
172	75	-	CALCULATE HALITE
173	43	RCL	
174	16	16	
175	55	÷	
176	02	2	
177	95	=	
178	42	STO	
179	07	07	
180	77	GE	
181	75	-	
182	65	×	
183	02	2	
184	95	=	
185	44	SUM	
186	16	16	
187	00	0	
188	42	STO	
189	07	07	
190	76	LBL	
191	75	-	
192	43	RCL	
193	16	16	
194	55	÷	
195	02	2	
196	95	=	
197	42	STO	
198	44	44	
199	43	RCL	
200	07	07	
201	32	X↕T	CALCULATE THENARDITE
202	43	RCL	
203	15	15	
204	77	GE	
205	61	GTO	
206	42	STO	
207	43	43	
208	61	GTO	
209	71	SBR	
210	76	LBL	

LOC	CODE	KEY	COMMENTS
211	61	GTO	
212	32	X↕T	
213	42	STO	
214	43	43	
215	76	LBL	
216	71	SBR	
217	94	+/-	
218	44	SUM	
219	07	07	
220	43	RCL	
221	43	43	
222	22	INV	
223	44	SUM	
224	15	15	
225	43	RCL	
226	15	15	
227	44	SUM	
228	18	18	
229	00	0	
230	32	X↕T	CALCULATE PYRITE
231	43	RCL	
232	04	04	
233	75	-	
234	43	RCL	
235	18	18	
236	55	÷	
237	02	2	
238	95	=	
239	42	STO	
240	04	04	
241	77	GE	
242	81	RST	
243	65	×	
244	02	2	
245	95	=	
246	44	SUM	
247	18	18	
248	00	0	
249	42	STO	
250	04	04	
251	76	LBL	
252	81	RST	
253	43	RCL	
254	18	18	
255	55	÷	
256	02	2	
257	95	=	
258	42	STO	
259	30	30	
260	43	RCL	
261	04	04	
262	75	-	
263	43	RCL	
264	19	19	

LOC	CODE	KEY	COMMENTS
265	95	=	
266	42	STO	CALCULATE CHROMITE
267	04	04	
268	77	GE	
269	97	DSZ	
270	44	SUM	
271	19	19	
272	00	0	
273	42	STO	
274	04	04	
275	76	LBL	
276	97	DSZ	
277	43	RCL	
278	19	19	
279	42	STO	
280	22	22	
281	43	RCL	
282	04	04	CALCULATE ILMENITE
283	32	X↕T	
284	43	RCL	
285	10	10	
286	77	GE	
287	87	IFF	
288	42	STO	
289	24	24	
290	61	GTO	
291	77	GE	
292	76	LBL	
293	87	IFF	
294	32	X↕T	
295	42	STO	
296	24	24	
297	76	LBL	
298	77	GE	
299	94	+/-	
300	44	SUM	
301	04	04	
302	43	RCL	
303	24	24	
304	22	INV	
305	44	SUM	
306	10	10	
307	43	RCL	
308	17	17	
309	75	-	
310	02	2	
311	55	÷	
312	03	3	
313	65	×	

MERGED CODES

62 [Exc] [Exc]	72 [STO] [Exc]	83 [GTO] [Exc]
63 [Exc] [Exc]	73 [RCL] [Exc]	84 [Exc] [Ind]
64 [Ind] [Ind]	74 [SUM] [Ind]	92 [INV] [SBR]

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TITLE PROGRAM 2, CARD SET 1 PAGE 21 OF ____

PROGRAMMER _____ DATE _____

TI Programmable **Coding Form**

LOC	CODE	KEY	COMMENTS
314	43	RCL	
315	28	28	ADJUST
316	95	=	FLUORINE
317	42	STO	FOR
318	17	17	APATITE
319	32	X:T	
320	00	0	
321	22	INV	
322	77	GE	
323	67	EQ	
324	00	0	
325	42	STO	
326	17	17	
327	76	LBL	
328	67	EQ	
329	00	0	
330	32	X:T	
331	43	RCL	
332	06	06	
333	75	-	
334	43	RCL	
335	17	17	
336	55	÷	
337	02	2	
338	95	=	
339	42	STO	
340	06	06	
341	77	GE	
342	57	ENG	
343	65	×	
344	02	2	
345	95	=	
346	44	SUM	
347	17	17	
348	00	0	
349	42	STO	
350	06	06	
351	76	LBL	
352	57	ENG	
353	43	RCL	
354	17	17	
355	55	÷	
356	02	2	
357	95	=	
358	42	STO	
359	29	29	
360	43	RCL	
361	06	06	CALCULATE
362	32	X:T	CALCITE
363	43	RCL	
364	14	14	
365	77	GE	
366	98	ADV	
367	42	STO	
368	31	31	
369	61	GTO	
370	88	DMS	
371	76	LBL	
372	98	ADV	
373	32	X:T	
374	42	STO	
375	31	31	
376	76	LBL	
377	88	DMS	
378	94	+/-	
379	44	SUM	
380	06	06	
381	43	RCL	
382	31	31	
383	22	INV	
384	44	SUM	
385	14	14	
386	43	RCL	
387	05	05	CALCULATE
388	32	X:T	MAGNESITE
389	43	RCL	
390	14	14	
391	77	GE	
392	78	Σ+	
393	42	STO	
394	32	32	
395	61	GTO	
396	68	NOP	
397	76	LBL	
398	78	Σ+	
399	32	X:T	
400	42	STO	
401	32	32	
402	76	LBL	
403	68	NOP	
404	94	+/-	
405	44	SUM	
406	05	05	
407	43	RCL	
408	32	32	
409	22	INV	
410	44	SUM	
411	14	14	
412	00	0	
413	42	STO	
414	17	17	
415	02	2	
416	92	RTN	

LOC	CODE	KEY	COMMENTS

MERGED CODES

62 [RCL] [RCL]	72 [STO] [ ]	83 [GTO] [ ]
63 [ ] [ ]	73 [RCL] [ ]	84 [ ] [ ]
64 [ ] [ ]	74 [SUM] [ ]	92 [INV] [SBR]

TEXAS INSTRUMENTS INCORPORATED

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TITLE PROGRAM 2, CARD SET 2 PAGE 22 OF _____

PROGRAMMER _____ DATE _____

TI Programmable **Coding Form**

LOC	CODE	KEY	COMMENTS
000	76	LBL	
001	13	C	
002	43	RCL	CALCULATE SIDERITE
003	14	14	
004	32	X:T	
005	00	0	
006	77	GE	
007	58	FIX	
008	43	RCL	
009	04	04	
010	77	GE	
011	48	EXC	
012	42	STO	
013	33	33	
014	61	GTO	
015	38	SIN	
016	76	LBL	
017	48	EXC	
018	32	X:T	
019	42	STO	
020	33	33	
021	76	LBL	
022	38	SIN	
023	43	RCL	
024	33	33	
025	22	INV	
026	44	SUM	
027	04	04	
028	43	RCL	
029	33	33	
030	22	INV	
031	44	SUM	
032	14	14	
033	76	LBL	
034	58	FIX	CALCULATE ZIRCON
035	00	0	
036	32	X:T	
037	43	RCL	
038	01	01	
039	75	-	
040	43	RCL	
041	13	13	
042	95	=	
043	42	STO	
044	01	01	
045	77	GE	
046	28	LOG	
047	44	SUM	
048	13	13	
049	00	0	
050	42	STO	
051	01	01	
052	76	LBL	
053	28	LOG	
054	00	0	
055	48	EXC	
056	13	13	
057	42	STO	
058	42	42	
059	00	0	
060	42	STO	
061	15	15	
062	42	STO	
063	14	14	
064	42	STO	
065	18	18	
066	42	STO	
067	23	23	
068	42	STO	
069	21	21	
070	32	X:T	
071	43	RCL	
072	02	02	
073	75	-	CALCULATE ORTHOCLASE, ALBITE
074	43	RCL	
075	08	08	
076	95	=	
077	42	STO	
078	49	49	
079	77	GE	
080	39	COS	
081	94	+/-	
082	42	STO	
083	14	14	
084	00	0	
085	48	EXC	
086	02	02	
087	42	STO	
088	41	41	
089	00	0	
090	42	STO	
091	08	08	
092	61	GTO	
093	30	TAN	
094	76	LBL	
095	39	COS	
096	42	STO	
097	02	02	
098	75	-	
099	43	RCL	
100	07	07	
101	95	=	
102	42	STO	
103	49	49	
104	00	0	
105	48	EXC	
106	08	08	
107	42	STO	
108	41	41	
109	77	GE	
110	49	PRD	
111	94	+/-	
112	42	STO	
113	07	07	
114	00	0	
115	48	EXC	
116	02	02	
117	42	STO	
118	40	40	
119	61	GTO	
120	30	TAN	
121	76	LBL	
122	49	PRD	
123	00	0	
124	48	EXC	
125	07	07	
126	42	STO	
127	40	40	
128	43	RCL	
129	49	49	
130	42	STO	
131	02	02	
132	75	-	
133	43	RCL	CALCULATE ANORTHITE
134	06	06	
135	95	=	
136	42	STO	
137	49	49	
138	77	GE	
139	59	INT	
140	94	+/-	
141	42	STO	
142	06	06	
143	00	0	
144	48	EXC	
145	02	02	
146	42	STO	
147	39	39	
148	61	GTO	
149	30	TAN	
150	76	LBL	
151	59	INT	
152	43	RCL	
153	06	06	
154	42	STO	
155	39	39	
156	43	RCL	

MERGED CODES

62 [x=t] [x≥t]	72 [STO] [op]	83 [GTO] [op]
63 [op] [op]	73 [RCL] [op]	84 [op] [op]
64 [Exc] [Exc]	74 [SUM] [Exc]	92 [INV] [SBR]

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PROGRAMMER ____ DATE ____

TI Programmable **Coding Form**

LOC	CODE	KEY	COMMENTS
157	49	49	
158	42	STO	CALCULATE CORUNDUM
159	45	45	
160	00	0	
161	42	STO	
162	02	02	
163	42	STO	
164	06	06	
165	76	LBL	
166	30	TAN	CALCULATE TITANITE SPHENE
167	43	RCL	
168	10	10	
169	75	-	
170	43	RCL	
171	06	06	
172	95	=	
173	42	STO	
174	49	49	
175	77	GE	
176	69	DP	
177	94	+/-	
178	42	STO	
179	06	06	
180	43	RCL	
181	10	10	
182	42	STO	
183	25	25	
184	61	GTO	
185	79	%	
186	76	LBL	
187	69	DP	CALCULATE RUTILE
188	00	0	
189	48	EXC	
190	06	06	
191	42	STO	
192	25	25	
193	43	RCL	
194	49	49	
195	42	STO	
196	27	27	
197	76	LBL	
198	79	%	
199	43	RCL	CALCULATE ACMITE
200	03	03	
201	75	-	
202	43	RCL	
203	07	07	
204	95	=	
205	42	STO	
206	49	49	
207	77	GE	
208	89	π	
209	94	+/-	
210	42	STO	
211	13	13	
212	43	RCL	
213	03	03	
214	42	STO	
215	12	12	
216	43	RCL	
217	04	04	CALCULATE FERROSILITE
218	42	STO	
219	17	17	
220	61	GTO	
221	99	PRT	
222	76	LBL	
223	89	π	
224	00	0	
225	48	EXC	
226	07	07	
227	42	STO	
228	12	12	
229	43	RCL	
230	49	49	
231	42	STO	
232	03	03	
233	75	-	
234	43	RCL	CALCULATE MAGNETITE
235	04	04	
236	95	=	
237	42	STO	
238	49	49	
239	77	GE	
240	90	LST	
241	94	+/-	
242	42	STO	
243	17	17	
244	43	RCL	
245	03	03	
246	42	STO	
247	21	21	
248	61	GTO	
249	99	PRT	
250	76	LBL	
251	90	LST	
252	43	RCL	
253	04	04	
254	42	STO	
255	21	21	
256	43	RCL	
257	49	49	CALCULATE HEMATITE
258	42	STO	
259	23	23	
260	76	LBL	
261	99	PRT	
262	00	0	
263	42	STO	
264	47	47	
265	42	STO	
266	48	48	
267	43	RCL	
268	05	05	
269	85	+	
270	43	RCL	
271	17	17	
272	95	=	
273	42	STO	
274	38	38	
275	32	X↕T	
276	00	0	
277	77	GE	
278	19	D'	
279	43	RCL	
280	05	05	
281	55	÷	
282	43	RCL	
283	38	38	
284	95	=	
285	42	STO	
286	47	47	
287	43	RCL	
288	17	17	
289	55	÷	
290	43	RCL	
291	38	38	
292	95	=	
293	42	STO	
294	48	48	
295	76	LBL	
296	19	D'	
297	00	0	
298	32	X↕T	
299	43	RCL	
300	38	38	
301	75	-	
302	43	RCL	
303	06	06	
304	95	=	
305	42	STO	
306	49	49	
307	22	INV	
308	77	GE	
309	50	I×I	
310	42	STO	
311	35	35	
312	43	RCL	
313	06	06	

MERGED CODES

62 [rcp] [lbl]		72 [STO] [lbl]		83 [GTO] [lbl]	
63 [lbl] [lbl]		73 [RCL] [lbl]		84 [lbl] [lbl]	
64 [lbl] [lbl]		74 [SUM] [lbl]		92 [INV] [SBR]	

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PROGRAMMER ____ DATE ____

TI Programmable **Coding Form**

LOC	CODE	KEY	COMMENTS
314	42	STO	
315	34	34	
316	61	GTO	
317	60	DEG	
318	76	LBL	
319	50	I×I	
320	94	+/-	
321	42	STO	
322	15	15	
323	43	RCL	
324	38	38	
325	42	STO	
326	34	34	
327	76	LBL	
328	60	DEG	
329	00	0	
330	48	EXC	REGISTER SWAPPING TO ARRANGE OUTPUT ORDER
331	39	39	
332	42	STO	
333	06	06	
334	00	0	
335	48	EXC	
336	40	40	
337	48	EXC	
338	05	05	
339	42	STO	
340	16	16	
341	43	RCL	
342	34	34	
343	48	EXC	
344	41	41	
345	42	STO	
346	37	37	
347	43	RCL	
348	35	35	
349	48	EXC	
350	42	42	
351	42	STO	
352	03	03	
353	00	0	
354	48	EXC	
355	43	43	
356	42	STO	
357	11	11	
358	00	0	
359	48	EXC	
360	44	44	
361	42	STO	
362	10	10	
363	00	0	
364	48	EXC	
365	45	45	
366	42	STO	
367	02	02	
368	00	0	
369	42	STO	
370	07	07	
371	42	STO	
372	08	08	
373	42	STO	
374	09	09	
375	42	STO	
376	19	19	
377	42	STO	
378	20	20	
379	43	RCL	
380	01	01	
381	75	-	
382	43	RCL	BALANCE SILICA
383	25	25	
384	75	-	
385	04	4	
386	65	×	
387	43	RCL	
388	12	12	
389	75	-	
390	43	RCL	
391	13	13	
392	75	-	
393	43	RCL	
394	14	14	
395	75	-	
396	06	6	
397	65	×	
398	53	(	
399	43	RCL	
400	37	37	
401	85	+	
402	43	RCL	
403	05	05	
404	54	)	
405	75	-	
406	43	RCL	
407	15	15	
408	75	-	
409	02	2	
410	65	×	
411	53	(	
412	43	RCL	
413	06	06	
414	85	+	
415	43	RCL	
416	41	41	
417	54	)	
418	75	-	
419	43	RCL	
420	42	42	
421	95	=	
422	42	STO	
423	01	01	
424	22	INV	
425	77	GE	
426	70	RAD	
427	42	STO	
428	39	39	
429	61	GTO	
430	10	E'	
431	76	LBL	
432	70	RAD	
433	43	RCL	CONVERT HYPERSTHENE TO OLIVINE AND SiO_2
434	01	01	
435	85	+	
436	43	RCL	
437	42	42	
438	95	=	
439	42	STO	
440	01	01	
441	03	3	
442	92	RTN	
443	76	LBL	
444	10	E'	
445	09	9	
446	92	RTN	

MERGED CODES

62 [PRD] [EXC]	72 [STO] [EXC]	83 [GTO] [EXC]
63 [EXC] [DSZ]	73 [RCL] [EXC]	84 [PRD] [EXC]
64 [PRD] [DSZ]	74 [SUM] [EXC]	92 [INV] [SBR]

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PROGRAMMER ____ DATE ____

TI Programmable Coding Form

LOC	CODE	KEY	COMMENTS
000	76	LBL	
001	13	C	
002	00	0	
003	32	X:T	
004	43	RCL	
005	01	01	
006	65	×	
007	02	2	
008	75	-	
009	43	RCL	
010	42	42	
011	95	=	
012	22	INV	
013	77	GE	
014	95	=	
015	32	X:T	
016	43	RCL	
017	42	42	
018	75	-	
019	43	RCL	
020	01	01	
021	95	=	
022	42	STO	
023	43	43	
024	00	0	
025	32	X:T	
026	42	STO	
027	42	42	
028	61	GTO	
029	15	E	
030	76	LBL	
031	95	=	
032	43	RCL	
033	42	42	
034	55	÷	
035	02	2	
036	95	=	
037	42	STO	
038	43	43	
039	00	0	
040	42	STO	
041	42	42	
042	43	RCL	CONVERT TITANITE TO PEROVSKITE AND SiO_2
043	01	01	
044	75	-	
045	43	RCL	
046	43	43	
047	85	+	
048	43	RCL	
049	25	25	
050	95	=	
051	42	STO	
052	01	01	
053	22	INV	
054	77	GE	
055	85	+	
056	94	+/-	
057	85	+	
058	43	RCL	
059	25	25	
060	95	=	
061	42	STO	
062	26	26	
063	43	RCL	
064	01	01	
065	42	STO	
066	25	25	
067	61	GTO	
068	15	E	
069	76	LBL	
070	85	+	
071	85	+	CONVERT ALBITE TO NEPHELINE AND SiO_2
072	06	6	
073	65	×	
074	43	RCL	
075	05	05	
076	95	=	
077	42	STO	
078	01	01	
079	00	0	
080	48	EXC	
081	25	25	
082	42	STO	
083	26	26	
084	43	RCL	
085	01	01	
086	75	-	
087	02	2	
088	65	×	
089	43	RCL	
090	05	05	
091	95	=	
092	42	STO	
093	49	49	
094	22	INV	
095	77	GE	
096	75	-	
097	43	RCL	
098	05	05	
099	65	×	
100	06	6	
101	95	=	
102	32	X:T	
103	43	RCL	
104	01	01	
105	77	GE	
106	75	-	
107	43	RCL	
108	05	05	
109	65	×	
110	01	1	
111	93	.	
112	05	5	
113	75	÷	
114	43	RCL	
115	01	01	
116	55	÷	
117	04	4	
118	95	=	
119	42	STO	
120	08	08	
121	43	RCL	
122	49	49	
123	55	÷	
124	04	4	
125	95	=	
126	42	STO	
127	05	05	
128	61	GTO	
129	15	E	
130	76	LBL	CONVERT ORTHOCLASE TO LEUCITE AND SiO_2
131	75	-	
132	00	0	
133	48	EXC	
134	05	05	
135	42	STO	
136	08	08	
137	43	RCL	
138	01	01	
139	75	-	
140	02	2	
141	65	×	
142	43	RCL	
143	08	08	
144	85	+	
145	06	6	
146	65	×	
147	43	RCL	
148	37	37	
149	95	=	
150	42	STO	
151	01	01	
152	75	-	
153	04	4	
154	65	×	
155	43	RCL	
156	37	37	

MERGED CODES

62 [HIR] [DRG]	72 [STO] [DRG]	83 [GTO] [DRG]
63 [DRG] [DRG]	73 [RCL] [DRG]	84 [DRG] [DRG]
64 [DRG] [DRG]	74 [SUM] [DRG]	92 [INV] [SBR]

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TITLE PROGRAM 2, CARD SET 3 PAGE 26 OF _____

PROGRAMMER _____ DATE _____

TI Programmable **Coding Form**

LOC	CODE	KEY	COMMENTS
157	95	=	
158	42	STO	
159	49	49	
160	32	X↕T	
161	00	0	
162	77	GE	
163	65	×	
164	06	6	
165	65	×	
166	43	RCL	
167	37	37	
168	95	=	
169	32	X↕T	
170	43	RCL	
171	01	01	
172	77	GE	
173	65	×	
174	43	RCL	
175	37	37	
176	65	×	
177	03	3	
178	75	-	
179	93	.	
180	05	5	
181	65	×	
182	43	RCL	
183	01	01	
184	95	=	
185	42	STO	
186	07	07	
187	43	RCL	
188	49	49	
189	55	÷	
190	02	2	
191	95	=	
192	42	STO	
193	37	37	
194	61	GTO	
195	15	E	
196	76	LBL	
197	65	×	
198	00	0	
199	48	EXC	
200	37	37	
201	42	STO	
202	07	07	
203	43	RCL	
204	01	01	
205	75	-	
206	04	4	
207	65	×	
208	43	RCL	
209	07	07	
210	85	+	

LOC	CODE	KEY	COMMENTS
211	43	RCL	
212	15	15	
213	95	=	
214	42	STO	CONVERT WOLLASTONITE TO CALCIUM ORTHOSILICATE AND SiO_2
215	01	01	
216	94	+/-	
217	85	+	
218	43	RCL	
219	15	15	
220	95	=	
221	42	STO	
222	49	49	
223	43	RCL	
224	01	01	
225	65	×	
226	02	2	
227	75	-	
228	43	RCL	
229	15	15	
230	95	=	
231	42	STO	
232	46	46	
233	32	X↕T	
234	00	0	
235	77	GE	
236	55	÷	
237	43	RCL	
238	49	49	
239	32	X↕T	
240	00	0	
241	77	GE	
242	55	÷	
243	32	X↕T	
244	42	STO	
245	20	20	
246	43	RCL	
247	46	46	
248	42	STO	
249	15	15	
250	61	GTO	
251	15	E	
252	76	LBL	
253	55	÷	
254	43	RCL	
255	01	01	
256	85	+	
257	02	2	
258	65	×	
259	43	RCL	
260	41	41	
261	95	=	
262	42	STO	
263	01	01	
264	75	-	

LOC	CODE	KEY	COMMENTS
265	43	RCL	
266	41	41	
267	95	=	
268	65	×	
269	02	2	
270	75	-	
271	43	RCL	
272	15	15	
273	95	=	
274	42	STO	
275	46	46	
276	43	RCL	
277	41	41	CONVERT DIOPSIDE TO CALCIUM ORTHOSILLICATE AND OLIVINE AND SiO_2
278	65	×	
279	04	4	
280	85	+	
281	43	RCL	
282	15	15	
283	75	-	
284	02	2	
285	65	×	
286	43	RCL	
287	01	01	
288	95	=	
289	42	STO	
290	44	44	
291	85	+	
292	02	2	
293	65	×	
294	43	RCL	
295	15	15	
296	95	=	
297	42	STO	
298	45	45	
299	32	X↕T	
300	00	0	
301	77	GE	
302	53	(	
303	43	RCL	
304	44	44	
305	32	X↕T	
306	00	0	
307	77	GE	
308	53	(	
309	43	RCL	
310	46	46	
311	32	X↕T	
312	00	0	
313	77	GE	

MERGED CODES

62 [prd] [inv]	72 [STO] [inv]	83 [GTO] [inv]
63 [inv] [inv]	73 [RCL] [inv]	84 [prd] [inv]
64 [inv] [inv]	74 [SUM] [inv]	92 [INV] [SBR]

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TITLE PROGRAM 2, CARD SET 3 PAGE 27 OF _____

PROGRAMMER _____ DATE _____

TI Programmable **Coding Form**

LOC	CODE	KEY	COMMENTS
314	53	(	
315	43	RCL	
316	45	45	
317	55	÷	
318	04	4	
319	95	=	
320	42	STO	
321	20	20	
322	43	RCL	
323	43	43	
324	85	+	
325	43	RCL	
326	44	44	
327	55	÷	
328	04	4	
329	95	=	
330	42	STO	
331	43	43	
332	43	RCL	
333	46	46	
334	55	÷	
335	02	2	
336	95	=	
337	42	STO	
338	41	41	
339	00	0	
340	42	STO	
341	15	15	
342	61	GTO	
343	15	E	
344	76	LBL	
345	53	(	
346	43	RCL	
347	41	41	CONVERT LEUCITE TO KALIOPHILITE AND SiO_2
348	55	÷	
349	02	2	
350	85	+	
351	43	RCL	
352	43	43	
353	95	=	
354	42	STO	
355	43	43	
356	43	RCL	
357	15	15	
358	85	+	
359	43	RCL	
360	41	41	
361	95	=	
362	55	÷	
363	02	2	
364	95	=	
365	42	STO	
366	20	20	
367	43	RCL	

LOC	CODE	KEY	COMMENTS
368	01	01	
369	75	-	
370	43	RCL	
371	41	41	
372	75	-	
373	43	RCL	
374	15	15	
375	55	÷	
376	02	2	
377	85	+	
378	04	4	
379	65	×	
380	43	RCL	
381	07	07	
382	95	=	
383	42	STO	
384	01	01	
385	00	0	
386	42	STO	
387	41	41	
388	42	STO	
389	15	15	
390	43	RCL	
391	01	01	
392	75	-	
393	02	2	
394	65	×	
395	43	RCL	
396	07	07	
397	95	=	
398	42	STO	
399	49	49	
400	43	RCL	
401	01	01	
402	75	-	
403	02	2	
404	65	×	
405	43	RCL	
406	49	49	
407	95	=	
408	42	STO	
409	46	46	
410	00	0	
411	32	X:T	
412	43	RCL	
413	49	49	
414	77	GE	
415	54	)	
416	85	+	
417	43	RCL	
418	43	43	
419	95	=	
420	42	STO	
421	43	43	

LOC	CODE	KEY	COMMENTS
422	00	0	
423	42	STO	
424	01	01	
425	00	0	
426	48	EXC	
427	07	07	
428	42	STO	
429	09	09	
430	61	GTO	
431	15	E	
432	76	LBL	
433	54	)	
434	43	RCL	
435	46	46	
436	55	÷	
437	02	2	
438	95	=	
439	42	STO	
440	09	09	
441	43	RCL	
442	49	49	
443	55	÷	
444	02	2	
445	95	=	
446	42	STO	
447	07	07	
448	76	LBL	
449	15	E	
450	00	0	
451	48	EXC	
452	39	39	
453	42	STO	
454	01	01	
455	00	0	
456	48	EXC	
457	37	37	
458	42	STO	
459	04	04	
460	43	RCL	
461	47	47	
462	42	STO	
463	44	44	
464	43	RCL	
465	48	48	
466	42	STO	
467	45	45	
468	04	4	
469	92	RTN	

MERGED CODES

62 PRINT PRINT
63 PRINT PRINT
64 PRINT PRINT
72 STO PRINT
73 RCL PRINT
74 SUM PRINT
83 GTO PRINT
84 PRINT PRINT
92 INV SBR

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TITLE PROGRAM 2, CARD SET 4 PAGE 28 OF _____

PROGRAMMER _____ DATE _____

TI Programmable **Coding Form**

LOC	CODE	KEY	COMMENTS
000	76	LBL	
001	13	C	
002	43	RCL	
003	41	41	
004	42	STO	
005	40	40	
006	65	×	
007	43	RCL	
008	44	44	
009	95	=	
010	42	STO	
011	39	39	
012	43	RCL	
013	45	45	
014	65	×	
015	43	RCL	
016	41	41	
017	95	=	
018	42	STO	
019	38	38	
020	43	RCL	
021	44	44	
022	65	×	
023	43	RCL	
024	42	42	
025	95	=	
026	42	STO	
027	37	37	
028	43	RCL	
029	45	45	
030	65	×	
031	43	RCL	
032	42	42	
033	95	=	
034	42	STO	
035	36	36	
036	43	RCL	
037	44	44	
038	65	×	
039	43	RCL	
040	43	43	
041	95	=	
042	42	STO	
043	35	35	
044	42	STO	
045	18	18	
046	43	RCL	
047	45	45	
048	65	×	
049	43	RCL	
050	43	43	
051	95	=	
052	42	STO	
053	34	34	

LOC	CODE	KEY	COMMENTS
054	42	STO	
055	19	19	
056	43	RCL	
057	40	40	
058	44	SUM	
059	15	15	
060	43	RCL	
061	39	39	
062	85	+	
063	43	RCL	
064	37	37	
065	95	=	
066	42	STO	
067	16	16	
068	43	RCL	
069	38	38	
070	85	+	
071	43	RCL	
072	36	36	
073	95	=	
074	42	STO	
075	17	17	
076	01	1	
077	42	STO	
078	00	00	
079	06	6	
080	00	0	
081	42	STO	
082	56	56	
083	98	ADV	
084	98	ADV	
085	76	LBL	PRINT THE FOLLOWING VALUES:
086	11	A	
087	73	RC*	
088	00	00	
089	65	×	
090	73	RC*	
091	56	56	
092	95	=	
093	72	ST*	
094	00	00	
095	99	PRT	
096	04	4	
097	00	0	
098	32	X:T	
099	43	RCL	
100	00	00	
101	77	GE	
102	14	D	
103	43	RCL	
104	56	56	
105	85	+	
106	01	1	
107	95	=	

q c z or ab an lc ne kp hl th ac ns ks wo en fs

LOC	CODE	KEY	COMMENTS
108	42	STO	
109	56	56	fo
110	69	OP	fa
111	20	20	cs
112	61	GTO	mt
113	11	A	cm
114	76	LBL	hm
115	14	D	il
116	43	RCL	tn
117	40	40	pf
118	85	+	ru
119	43	RCL	ap
120	39	39	fr
121	85	+	pr
122	43	RCL	cc
123	38	38	mg
124	95	=	sd
125	99	PRT	ol-fa
126	43	RCL	ol-fo
127	37	37	hy-fs
128	85	+	hy-en
129	43	RCL	di-fs
130	36	36	di-en
131	95	=	di-wo
132	99	PRT	di
133	43	RCL	hy
134	35	35	ol
135	85	+	wol
136	43	RCL	
137	34	34	
138	95	=	
139	99	PRT	
140	43	RCL	
141	15	15	
142	75	-	
143	43	RCL	
144	40	40	
145	95	=	
146	99	PRT	
147	92	RTN	

MERGED CODES

62 PRINT PRINT	72 STO LOG	83 GTO LOG
63 PRINT PRINT	73 RCL LOG	84 PRINT LOG
64 PRINT LOG	74 SUM LOG	92 INV SBR

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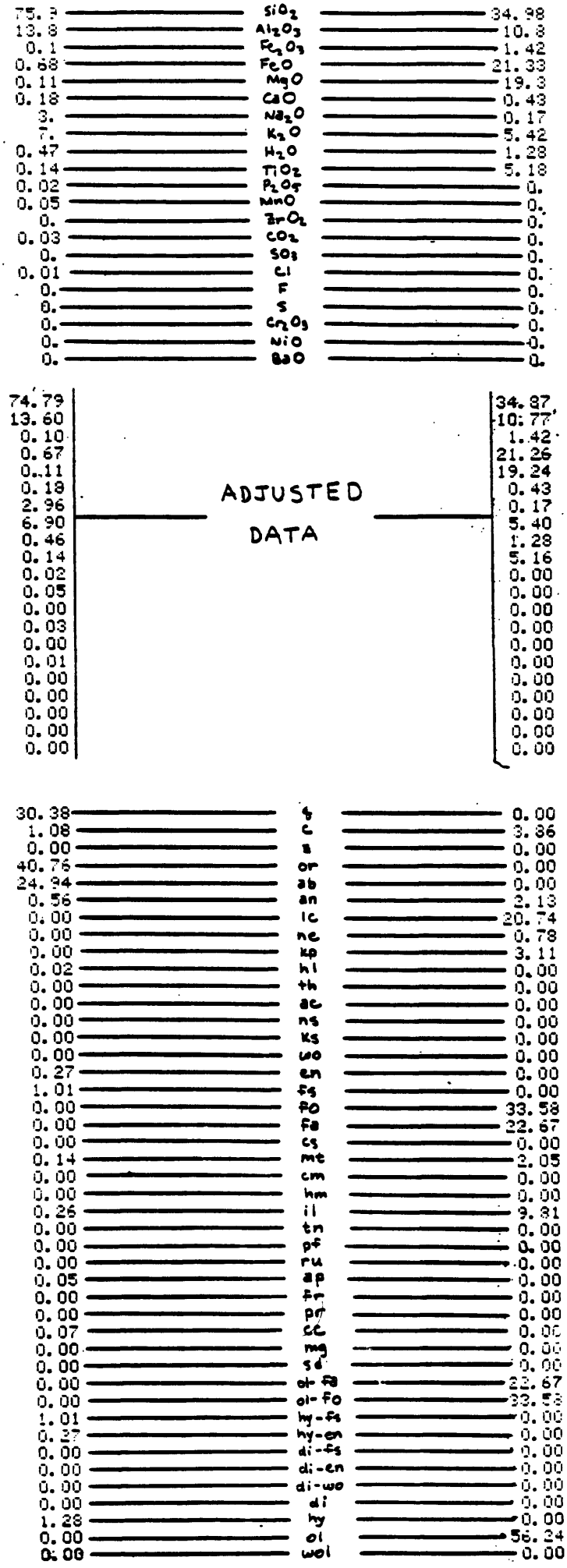
EXAMPLE 1

EXAMPLE 2



EXAMPLE 3

48.3	SiO_2	55.9
14.8	Al_2O_3	30.5
2.4	Fe_2O_3	2.65
9.1	FeO	1.58
8.1	MgO	0.87
10.	CaO	2.98
1.26	Na_2O	9.04
0.12	K_2O	4.26
3.63	H_2O	0.39
0.68	TiO_2	0.76
0.13	P_2O_5	0.17
0.21	MnO	0.2
0.	ZrO_2	0.13
0.	CO_2	0.01
0.	SO_3	0.
1.4	Cl	0.
0.	F	0.11
0.	S	0.
0.	Cr_2O_3	0.
0.	NiO	0.
0.	BaO	0.1

48.24		56.10
14.78		20.57
2.40		2.66
9.09		1.59
8.09		0.87
9.99	ADJUSTED	2.99
1.26		9.07
0.12	DATA	4.27
3.63		0.39
0.68		0.76
0.13		0.17
0.21		0.20
0.00		0.13
0.00		0.01
0.00		0.00
1.40		0.00
0.00		0.11
0.00		0.00
0.00		0.00
0.00		0.00
0.00		0.10

10.03	q	0.00
0.00	c	0.00
1.00	z	0.19
0.71	or	25.26
0.31	ab	37.84
39.81	an	2.79
0.00	lc	0.00
0.00	ne	21.08
0.00	kp	0.00
1.30	hl	0.00
0.00	th	0.00
0.00	ac	0.00
0.00	ns	0.00
0.00	ks	0.00
3.71	wo	4.32
20.15	en	2.17
13.98	fs	0.00
0.00	fo	0.00
0.00	fa	0.00
0.00	cs	0.00
2.48	mt	3.55
0.00	cm	0.00
0.00	hm	0.21
1.29	il	1.45
0.00	tn	0.00
0.00	pf	0.00
0.00	ru	0.00
0.31	ap	0.40
0.00	fr	0.20
0.00	pr	0.00
0.00	cc	0.02
0.00	mg	0.00
0.00	sd	0.00
0.00	ol-fa	0.00
0.00	ol-fo	0.00
12.52	hy-fs	0.00
13.05	hy-en	0.00
1.46	di-fs	0.00
2.10	di-en	1.17
3.11	di-wo	1.53
7.22	di	4.69
30.57	hy	0.00
0.00	ol	0.00
0.00	wol	1.81

EXAMPLE 4