Two More Moon Tracking Computer Programs

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AS-49-24

4228

The first moon tracking computer program included here was rewritten from WA1JXN/WA3GPL and K5JL versions presented in earlier issues of the EME notes. Warren Butler, W2WD, wrote the program for TRS-80 level II BASIC(16K). Cassette copies of the program are available from Warren for the cost of the cassette and postage (approximately $1.00).

The second program was written in FORTRAN IV by Geoffrey Grayer, G3NAQ. Again the WA1JXN/WA3GPL program served as the starting point for this effort.

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1Ø '                COORDINATES OF THE MOON
2Ø PRINT
3Ø ' DISLAYS GHA, DECLINATION, AZIMUTH, ELEVATION OF THE MOON
4Ø ' FROM A SELECTED LATITUDE, LONGITUDE FOR SELECTED DATES
5Ø ' AND TIMES (GMT).  EASTERN STANDARD TIME IS SHOWN BUT CAN BE CHANGED--
6Ø ' @ LINE 2Ø4Ø, CHANGE 5ØØ TO TIME DIFFERENTIAL DESIRED--
7Ø ' EG., FOR PACIFIC STANDARD TIME, USE 8ØØ IN PLACE OF 5ØØ.
8Ø ' @ LINES 85Ø & 86Ø CHANGE EST TO TIME ZONE DESIRED--
9Ø ' EG., REPLACE EST WITH PST FOR THE EXAMPLE BEING USED.
1ØØ ' HARDCOPY OUTPUT CAN BE SELECTED IF PRINTER IS AVAILABLE;
11Ø ' OTHERWISE, DATA WILL BE DISPLAYED ON CRT ONLY.
12Ø PRINT
13Ø ' BASED ON PROGRAMS BY LANCE COLLISTER, WA1JXN/WA3GPL AND
14Ø ' JAY LIEBMANN, K5JL.
15Ø ' MODIFIED FOR TRS-8Ø LEVEL II BASIC (16K) BY WARREN BUTLER,W2WD
16Ø PRINT                                                    (4/4/79).
17Ø ' DATA FOR UP TO 31 DAYS CAN BE REQUESTED---EACH TIME THE
18Ø ' COMPUTER ASKS FOR AN INPUT BY PRINTING ?, ENTER DATA IN
19Ø ' THE FORMAT REQUESTED.  AFTER THE LAST INPUT, INSERT ZEROS
2ØØ ' IN THE SAME FORMAT.
21Ø ' ANSWER OTHER QUESTIONS AS APPROPRIATE
22Ø ' UNIVERSAL WINDOWS ARE SHOWN BY LETTERS FOLLOWING DEC VALUES
23Ø ' U = EUROPEAN UNIVERSAL WINDOW
24Ø ' W = W/VE UNIVERSAL WINDOW
25Ø ' J = J/VK/ZL UNIVERSAL WINDOW
26Ø CLEAR 5ØØ
27Ø DIM F(31),V(31),Y(31),Q(31),S(31)
28Ø  P5=2.ØØØØØØØØØ*3.1415926535
29Ø  D5=36Ø.ØØØØØØØØØØ/P5
3ØØ R5=P5/36Ø.ØØØØØØØØØØ
31Ø CLS:PRINT:PRINT:PRINT:PRINT"WHAT ARE THE STATION CALL LETTERS";
32Ø INPUT W$
33Ø PRINT"WHAT IS YOUR LATITUDE IN DEGREES, MINUTES";
34Ø INPUT L5,U5
35Ø PRINT"WHAT IS YOUR LONGITUDE IN DEGREES, MINUTES";
36Ø INPUT L6,U6
37Ø  L5=(L5+U5/6Ø)*R5
38Ø  L6=(L6+U6/6Ø)*R5
39Ø PRINT"WHAT IS THE DESIRED PRINTING INCREMENT IN MINUTES";
4ØØ INPUT I
41Ø INPUT"DO YOU ONLY WANT PRINTOUT WHEN THE MOON IS NEAR THE HORIZON
     Ø)";B$                                                  (YES/
43Ø IF B$="YES" THEN 46Ø
44Ø LET I6=1ØØ
45Ø GOTO 55Ø
46Ø INPUT"BELOW WHAT ELEVATION IN DEGREES DO YOU WANT PRINTOUT";I6
47Ø INPUT"DO YOU WANT HARDCOPY PRINTOUT (YES/NO)";WW$
48Ø PRINT"WHAT ARE THE GMT MONTH, DAY, YEAR DESIRED?"
49Ø PRINT"USE FORMAT MM,DD,YYYY ---- 4-DIGITS FOR YEAR"
5ØØ FOR N=1 TO 31
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51Ø INPUT F(N), V(N), Y(N)
52Ø IF F(N)=Ø THEN 64Ø
53Ø NEXT N
54Ø GOTO 5ØØ
55Ø INPUT"DO YOU WANT HARDCOPY (YES/NO)";WW$
56Ø PRINT
57Ø PRINT"WHAT ARE THE GMT MONTH, DAY, YEAR, TIME BEGINNING, TIME ENDING?"
58Ø PRINT"USE THE FORMAT MM,DD,YYYY,TTTT,TTTT
REMINDER --- USE 4 DIGITS FOR YEAR!"
59Ø FOR N=1TO31
6ØØ INPUT F(N), V(N), Y(N), Q(N), S(N)
61Ø IF F(N)=Ø THEN 64Ø
62Ø NEXT N
63Ø GOTO 59Ø
64Ø  N5=N-1
65Ø FOR N=1 TO N5
66Ø IF B$="YES" THEN 68Ø
67Ø GOTO 71Ø
68Ø  E1=24ØØ
69Ø B=Ø
7ØØ GOTO 73Ø
71Ø  E1=S(N)
72Ø  B=Q(N)
73Ø  M=F(N)
74Ø  D=V(N)
75Ø  Y=Y(N)
76Ø  Y1=Y-(INT(Y/1ØØ)*1ØØ)
77Ø PRINT
78Ø IF WW$="YES" LPRINT
79Ø PRINT:CLS
8ØØ IF WW$="YES" LPRINT
81Ø PRINT"POSITION OF THE MOON ON ";M;"/";D;"/";Y1;" GMT FROM"" "W$
82Ø IF WW$="YES" LPRINT"POSITION OF THE MOON ON ";M;"/";D;"/";Y1;" GMT FROM"" "W
    $
83Ø PRINT
84Ø IF WW$="YES" LPRINT
85Ø PRINT"GMT"TAB(11)"GHA"TAB(21)"DEC"TAB(35)"EST"TAB(47)"AZ"TAB(57)"EL"
86Ø IF WW$="YES" LPRINT"GMT"TAB(11)"GHA"TAB(21)"DEC"TAB(35)"EST"TAB¢47)"AZ"TAB(5
    7)"EL"
87Ø PRINT
88Ø IF WW$="YES" LPRINT
89Ø I1=2
9ØØ IF M>=3 THEN 98Ø
91Ø IF INT((Y-1853)/4)<11 THEN 94Ø
92Ø  C1=-1
93Ø GOTO 95Ø
94Ø C1=Ø
95Ø  J1=365*(Y-1853)+D+3Ø*(M+9)+INT((M+1Ø)/2)
96Ø J2=INT((Y-1853)/4)+1+C1
97Ø GOTO 1Ø9Ø
98Ø IF INT((Y-1852)/4)<11 THEN 1Ø1Ø
99Ø C1=-1
1ØØØ GOTO 1Ø2Ø
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1Ø1Ø  C1=Ø
1Ø2Ø IF M=9 THEN 1Ø6Ø
1Ø3Ø IF M=11 THEN 1Ø6Ø
1Ø4Ø C2=Ø
1Ø5Ø GOTO 1Ø7Ø
1Ø6Ø  C2=1
1Ø7Ø J1=365*(Y-1852)+D+3Ø*(M-3)+INT((M-2)/2)
1Ø8Ø  J2=INT((Y-1852)/4)+C1+C2
1Ø9Ø J=J1+J2
11ØØ T1=J-17472.5
111Ø D9=(B-INT(B/1ØØ)*1ØØ)+INT(B/1ØØ)*6Ø
112Ø D6=(E1-INT(E1/1ØØ)*1ØØ)+INT(E1/1ØØ)*6Ø
113Ø D7=D9-D6
114Ø D8=D7-I
115Ø IF D7>Ø THEN 117Ø
116Ø GOTO 119Ø
117Ø IF D8>=Ø THEN 215Ø
118Ø B=E1
119Ø T=(B-INT(B/1ØØ)*1ØØ)/144Ø+INT(B/1ØØ)/24
12ØØ T5=T1+T
121Ø K1=((.751213+.Ø366Ø11Ø2*T5)-INT(.751213+.Ø366Ø11Ø2*T5))*P5
122Ø K2=((.822513+.Ø362916457*T5)-INT(.822513+.Ø362916457*T5))*P5
123Ø K3=((.995766+.ØØ273777852*T5)-INT(.995766+.ØØ273777852*T5))*P5
124Ø K4=((.974271+.Ø338631922*T5)-INT(.974271+.Ø338631922*T5))*P5
125Ø K5=((.Ø312525+.Ø367481957*T5)-INT(.Ø312525+.Ø367481957*T5))*P5
126Ø L8=K1+.658*R5*SIN(2*K4)+6.289*R5*SIN(K2)
127Ø L8=L8-1.274*R5*SIN(K2-2*K4)-.186*R5*SIN(K3)
128Ø L8=L8+.214*R5*SIN(2*K2)-.114*R5*SIN(2*K5)
129Ø L8=L8-.Ø59*R5*SIN(2*K2-2*K4)-.Ø57*R5*SIN(K2+K3-2*K4)
13ØØ K6=K5+.6593*R5*SIN(2*K4)+6.23Ø3*R5*SIN(K2)-1.272*R5*SIN(K2-2*K4)
131Ø L7=5.144*R5*SIN(K6)-.146*R5*SIN(K5-2*K4)
132Ø LET D1=COS(L7)*SIN(L8)*.397821+SIN(L7)*.917463
133Ø LET D1=ATN(D1/(SQR(1-D1±2)))
134Ø G1=5Ø+.5+((D1)/(.792))*D5
135Ø G2=8Ø+((D1)/(.8Ø8))*D5
136Ø G3=141.5-((D1)*(.738)*D5)
137Ø G4=17Ø.5-((D1)*(.857)*D5)
138Ø A2=COS(L7)*COS(L8)/COS(D1)
139Ø A1=(COS(L7)*SIN(L8)*.917463-SIN(L7)*.397821)/COS(D1)
14ØØ A=ATN(A1/A2)
141Ø GOSUB 167Ø
142Ø R1=A
143Ø L1=.Ø657Ø9822*T1
144Ø L=T*24*1.ØØ2738+6.646Ø55+(L1-INT(L1/24)*24)
145Ø L=(L-INT(L/24)*24)
146Ø G=(L/24)*P5-R1
147Ø IF G<P5 THEN 15ØØ
148Ø G=G-P5
149Ø GOTO 153Ø
15ØØ IF G<Ø THEN 152Ø
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151Ø GOTO 153Ø
152Ø G=G+P5
153Ø H=L6-G
154Ø E3=COS(L5)*COS(H)*COS(D1)+SIN(D1)*SIN(L5)
155Ø E2=SQR(1-(E3*E3))
156Ø E=ATN((E3/E2)-(1/(61.33*E2)))
157Ø F=ATN(E3/E2)
158Ø IF E<Ø THEN 21ØØ
159Ø IF E>16*R5 THEN 21ØØ
16ØØ A2=SIN(D1)/(COS(L5)*COS(F))
161Ø A2=A2-(SIN(L5)/COS(L5))*(SIN(F)/COS(F))
162Ø A1=SIN(L5)*SIN(D1)+COS(L5)*COS(D1)*COS(H)
163Ø A1=(SIN(H)*COS(D1))/SQR(1-A1±2)
164Ø A=ATN(A1/A2)
165Ø GOSUB 167Ø
166Ø GOTO 182Ø
167Ø IF A=Ø THEN 169Ø
168Ø GOTO 173Ø
169Ø IF A2<Ø THEN 171Ø
17ØØ GOTO 181Ø
171Ø A=P5/2
172Ø GOTO 181Ø
173Ø IF A>Ø THEN 179Ø
174Ø IF A2<Ø THEN 177Ø
175Ø A=P5+A
176Ø GOTO 181Ø
177Ø A=P5+(A-P5/2)
178Ø GOTO 181Ø
179Ø IF A2=>Ø THEN 181Ø
18ØØ A=A+P5/2
181Ø RETURN
182Ø IF (T-I1)>(2*I)/144Ø THEN 184Ø
183Ø GOTO 185Ø
184Ø PRINT
185Ø BS=INT(B+.5):BS$="**##"
186Ø Z1=INT(A*D5*1Ø+.5)/1Ø
187Ø Z2=INT(E*D5*1Ø+.5)/1Ø
188Ø Z3=INT(G*D5*1Ø+.5)/1Ø
189Ø Z4=INT(D1*D5*1Ø+.5)/1Ø
19ØØ IF Z4<Ø THEN 2Ø3Ø
191Ø IF Z3<G1 THEN 2Ø3Ø
192Ø IF Z3>G2 THEN 194Ø
193Ø GOTO 197Ø
194Ø IF Z3<G3 THEN 199Ø
195Ø IF Z3>G4 THEN 2Ø3Ø
196Ø GOTO 2Ø1Ø
197Ø Y$="U"
198Ø GOTO 2Ø4Ø
199Ø Y$="W"
2ØØØ GOTO 2Ø4Ø
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```
2Ø1Ø Y$="J"
2Ø2Ø GOTO 2Ø4Ø
2Ø3Ø Y$=" "
2Ø4Ø ES=(INT(B+.5))-5ØØ
2Ø5Ø IFES<=ØTHENES=ES+24ØØ
2Ø6Ø ES$="%%##"
2Ø7Ø PRINTUSINGBS$;BS;:PRINTTAB(1Ø)Z3TAB(2Ø)Z4;Y$TAB(35)USINGES$;ES;:PRINTTAB(45
     )Z1TAB(55)Z2
2Ø8Ø IF WW$="YES" LPRINTUSINGBS$;BS;:LPRINTTAB(1Ø)Z3TAB(2Ø)Z4;Y$TAB(35)USINGES$;
     ES;:LPRINTTAB(45)Z1TAB(55)Z2
2Ø9Ø I1=T
21ØØ B=B+I
211Ø Z=(B-INT(B/1ØØ)*1ØØ)-6Ø
212Ø IF Z<Ø THEN 111Ø
213Ø B=INT(B/1ØØ)*1ØØ+1ØØ+Z
214Ø GOTO 111Ø
215Ø NEXT N
216Ø N=Ø
217Ø PRINT
218Ø PRINT
219Ø PRINT"DO YOU WANT MORE INFORMATION (YES/NO)";
22ØØ INPUT D$
221Ø IF D$="YES" THEN 28Ø
2??Ø END
```

POSITION OF THE MOON ON 5 / 19 / 79 GMT FROM W2WD

GMT	GHA	DEC	EDT	AZ	EL
*615	357.4	-10	*215	106	2.2
*630	1	-9.9	*230	108.4	4.9
*645	4.6	-9.9	*245	110.8	7.5
*700	8.2	-9.8	*300	113.4	10.1
*715	11.8	-9.8	*315	115.9	12.6
*730	15.4	-9.8	*330	118.6	15.1
*745	19.1	-9.7	*345	121.3	17.5
*800	22.7	-9.7	*400	124.2	19.8
*815	26.3	-9.6	*415	127.2	22.1
*830	29.9	-9.6	*430	130.3	24.3
*845	33.5	-9.6	*445	133.5	26.4
*900	37.1	-9.5	*500	136.9	28.4
*915	40.8	-9.5	*515	140.4	30.3
*930	44.4	-9.4	*530	144.1	32
*945	48	-9.4	*545	147.9	33.6
1000	51.6	-9.4	*600	151.9	35
1015	55.2	-9.3	*615	156.1	36.2
1030	58.8	-9.3	*630	160.4	37.3
1045	62.5	-9.2	*645	164.8	38.2
1100	66.1	-9.2	*700	169.3	38.8
1115	69.7	-9.1	*715	174	39.3
1130	73.3	-9.1	*730	178.6	39.5
1145	76.9	-9.1	*745	183.3	39.5
1200	80.5	-9	*800	188	39.3
1215	84.2	-9	*815	192.6	38.8
1230	87.8	-8.9	*830	197.1	38.2
1245	91.4	-8.9	*845	201.5	37.3
1300	95	-8.9	*900	205.8	36.2
1315	98.6	-8.8	*915	210	35
1330	102.2	-8.8	*930	214	33.5
1345	105.9	-8.7	*945	217.9	31.9
1400	109.5	-8.7	1000	221.5	30.2
1415	113.1	-8.6	1015	225.1	28.3
1430	116.7	-8.6	1030	228.5	26.4
1445	120.3	-8.6	1045	231.7	24.3
1500	123.9	-8.5	1100	234.8	22.1
1515	127.6	-8.5	1115	237.8	19.8
1530	131.2	-8.4	1130	240.7	17.5
1545	134.8	-8.4	1145	243.5	15.1
1600	138.4	-8.4	1200	246.2	12.6
1615	142	-8.3	1215	248.8	10.1
1630	145.6	-8.3	1230	251.4	7.6
1645	149.3	-8.2	1245	253.9	4.9
1700	152.9	-8.2	1300	256.3	2.3

```
C
C THIS PROGRAM IS DESIGNED TO CALCULATE THE AZIMUTH AND ELEVATION OF THE MOON
C
C THIS IS A FORTRAN VERSION OF PROGRAM 3 OF THE EIMAC EME NOTE AS-49-6
C ORIGINALLY WRITTEN BY LANCE COLLISTER WA3GPL, CONVERTED BY GEOFF GRAYER G3NAQ.
C
C THE INPUT FORMAT IS AS FOLLOWS...
C
C FIRST DATA CARD:
C OPTIONAL IDENTIFICATION (A10), LAT. OF STATION DEGS.(I10), LAT. OF STATION
C MINS. (I10), LONG. OF STATION DEGS. (I10), LONG. OF STATION MINS. (I10).
C
C SECOND AND SUBSEQUENT DATA CARDS:
C YEAR (I10), MONTH (I10), DAY (I10), START HRS.MINS.(I10), STOP HRS.MINS.(I10)
C TIME INCREMENT MINS.(I10) - DEFAULT 10 MINS., MAXIMUM ELEVATION DEGS. (I10) -
C MAY BE USED TO SELECT PRINTOUT ONLY WHEN THE MOON IS NEAR THE HORIZON -
C DEFAULT 90 DEGS.
C
C ALL TIMES ARE IN GMT USING THE 0000 TO 2400 HOUR SYSTEM.
C
C A BLANK CARD DENOTES THE END OF THE DATA SET AND TERMINATES THE PROGRAM.
C
C PRINTOUT IS SUSPENDED WHENEVER THE ELEVATION OF THE MOON IS NEGATIVE.
C
C FOR FURTHER INFORMATION, REFER TO THE EIMAC NOTE.
C
C                                                   GEOFFREY H. GRAYER G3NAQ
C                                                   BRIGHTWALTON, BERKSHIRE
C                                                   APRIL, 1978
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
      INTEGER D,Y,C1,C2,B,Z,E1,D6,D7,D8,D9,GMT
      REAL    PI,P5,D5,R5,K1,K2,K3,K4,K5,L8,K6,L7,D1,A1,A2,A,L1,L,E3,E2
      REAL    L5,L6,I1
      REAL*4 JD
      DIMENSION IDENT(10),GMT(4)
      FNA(X)=AINT(X*D5*10.+0.5)/10.
      FNB(X)=(X-AINT(X))*P5
      PI=3.1415926535
      P5=2.*PI
      D5=180./PI
      R5=PI/180.
C READ STATION IDENT, LAT DEGS, LAT MINS, LONG DEGS, LONG MINS
      READ (5,1) IDENT,LATD,LATM,LONGD,LONGM
    1 FORMAT (10A1,4I10)
      L5=(LATD+LATM/60.)*R5
      L6=(LONGD+LONGM/60.)*R5
   10 CONTINUE
C READ YEAR,MONTH,DAY,(START TIME GMT),(END TIME GMT),(TIME INCREMENT MINS),
C     (MAXIMUM ELEVATION DEGS )
      READ (5,2) Y,M,D,B,E1,I,I6
    2 FORMAT(7I10)
      IF(Y.EQ.0) STOP
      IF(I.EQ.0) I=10
      IF(I6.EQ.0) I6=100
      IF(E1.EQ.0) E1=2400
      I1=2
C CALCULATE JULIAN DATE
      IF (M.GE.3) GO TO 16
      C1=-1
      IF(((Y-1853)/4).LT.11) C1=0
      J1=365*(Y-1853) + 30*(M+9) + ((M+10)/2) + D
      J2=((Y-1853)/4) + C1 + 1
      GO TO 27
   16 C1=-1
      IF (((Y-1852)/4).LT.11) C1=0
      IF (M.EQ.9.OR.M.EQ.11) GO TO 24
   22 C2=0
      GO TO 25
   24 C2=1
   25 J1=365*(Y-1852) + 30*(M-3) + ((M-2)/2) + D
      J2= ((Y-1852)/4) + C1 + C2
   27 J=J1+J2
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0039                    T1=FLOAT(J)-17472.5
0040                    JD=FLOAT(J)+2397547.5
0041                    WRITE (6,3) IDENT,LATD,LATM,LONGD,LONGM,Y,M,D,JD
0042                  3 FORMAT ('1LUNAR COORDINATES FOR ',10A1/' STATION  LAT: ',2I4,'
                     +LONG: ',2I4/' DATE  ',I4,'/',I2,'/',I2,'   JD=',F12.1//)
0043                    WRITE(6,5)
0044                  5 FORMAT('     GMT          AZ          EL          GHA          DEC'/)
0045                 29 D9=B - (B/100)*100 + (B/100)*60
0046                    D6= E1 - (E1/100)*100 + (E1/100)*60
0047                    D7=D9-D6
0048                    D8=D7-I
0049                    IF(D7.LE.0) GO TO 38
0050                    IF(D8.GE.0) GO TO 10
0051                    B=E1
                C CALCULATE LUNAR LAT AND LONG
0052                 38 T=FLOAT(B-(B/100)*100)/1440.+FLOAT(B/100)/24.
0053                    T5=T1+T
0054                    K1=FNB(0.751213+0.036601102*T5)
0055                    K2=FNB(0.822513+0.036291645 7*T5)
0056                    K3=FNB(0.995766+0.00273777852*T5)
0057                    K4=FNB(0.974271+0.033863192 2*T5)
0058                    K5=FNB(0.0312525+0.036748195 7*T5)
0059                    L8=K1+0.658*R5*SIN(2.*K4)+6.289*R5*SIN(K2)
0060                    L8=L8-1.274*R5*SIN(K2-2.*K4)-0.186*R5*SIN(K3)
0061                    L8=L8+0.214*R5*SIN(2.*K2)-0.114*R5*SIN(2.*K5)
0062                    L8=L8-0.059*R5*SIN(2.*K2+2.*K4)-0.057*R5*SIN(K2+K3-2.*K4)
0063                    K6=K5+.6593*R5*SIN(2.*K4)+6.2303*R5*SIN(K2)-1.272*R5*SIN(K2-2.*K4)
0064                    L7=5.144*R5*SIN(K6)-0.146*R5*SIN(K5-2.*K4)
                C CALCULATION OF RA AND DEC
0065                    D1=COS(L7)*SIN(L8)*0.397821+SIN(L7)*0.917463
0066                    D1=ATAN2(D1,SQRT(1.-D1**2))
0067                    A2=COS(L7)*COS(L8)/COS(D1)
0068                    A1=(COS(L7)*SIN(L8)*0.917463-SIN(L7)*0.397821)/COS(D1)
0069                    A=ATAN2(A1,A2)
0070                    R1=A
0071                    L1=0.065709822*T1
0072                    L=T*24.*1.002738+6.646055+(L1-AINT(L1/24)*24.)
0073                    L=(L-AINT(L/24)*24)
                C CALCULATION OF GREENWICH HOUR ANGLE G FROM LOCAL SIDERIAL TIME
0074                    G=(L/24)*P5-R1
0075                    IF(G.LT.P5) GO TO 67
0076                    G=G-P5
0077                    GO TO 71
0078                 67 IF(G.LT.0.) GO TO 69
0079                    GO TO 71
0080                 69 G=G+P5
                C CALCULATION OF LOCAL HOUR ANGLE H FROM GHA
0081                 71 H=L6-G
                C CALCULATION OF ELEVATION E
0082                    E3=COS(L5)*COS(H)*COS(D1)+SIN(D1)*SIN(L5)
0083                    E2=SQRT(1-E3**2)
0084                    E=ATAN2(E3,E2)
0085                    IF(E.LT.0.) GO TO 117
0086                    IF(E.GT.(16*R5)) GO TO 117
                C CALCULATION OF AZIMUTH A
0087                    A2=SIN(D1)/(COS(L5)*COS(E))
0088                    A2=A2-(SIN(L5)/COS(L5))*(SIN(E)/COS(E))
0089                    A1=SIN(L5)*SIN(D1)+COS(L5)*COS(D1)*COS(H)
0090                    A1=(SIN(H)*COS(D1))/SQRT(1.-A1**2)
0091                    A=ATAN2(A1,A2)
0092                    AZ=FNA(A)
0093                    EL=FNA(E)
0094                    GHA=FNA(G)
0095                    DEC=FNA(D1)
0096                    GMT(1)=B/1000
0097                    GMT(2)=B/100-(B/1000)*10
0098                    GMT(3)=B/10-(B/100)*10
0099                    GMT(4)=B-(B/10)*10
0100                    IF((T-I1).GT.(2.*I/1440.)) WRITE (6,7)
0101                  7 FORMAT(1H )
0102                104 WRITE(6,6) GMT,AZ,EL,GHA,DEC
0103                  6 FORMAT(3H    ,4I1,4F12.1)
0104                    I1=T
0105                117 B=B+I
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```
0106                    Z=B-(B/100)*100 - 60
0107                    IF(Z.LT.0) GO TO 29
0108                    B=(B/100)*100 + 100 + Z
0109                    GO TO 29
0110                    END
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LUNAR COORDINATES FOR G3NAQ
STATION LAT: 51 34 LONG: 1 18
DATE 1978/ 5/20 JD= 2443648.0

GMT	AZ	EL	GHA	DEC
0000	-143.7	24.3	34.2	-7.7
0010	-141.3	23.3	36.6	-7.7
0020	-138.9	22.4	39.0	-7.7
0030	-136.6	21.3	41.5	-7.8
0040	-134.4	20.3	43.8	-7.8
0050	-132.1	19.1	46.3	-7.8
0100	-129.9	18.0	48.7	-7.8
0110	-127.7	16.8	51.1	-7.9
0120	-125.6	15.6	53.4	-7.9
0130	-123.4	14.3	56.0	-7.9
0140	-121.4	13.0	58.4	-7.9
0150	-119.4	11.7	60.7	-8.0
0200	-117.4	10.4	63.1	-8.0
0210	-115.4	9.0	65.5	-8.0
0220	-113.3	7.6	68.0	-8.0
0230	-111.5	6.2	70.4	-8.1
0240	-109.6	4.8	72.8	-8.1
0250	-107.6	3.3	75.2	-8.1
0300	-105.8	1.9	77.6	-8.2
0310	-103.9	0.4	80.0	-8.2
1720	107.2	0.1	285.0	-10.5
1730	109.1	1.5	287.4	-10.5
1740	111.0	2.8	289.7	-10.5
1750	113.0	4.2	292.1	-10.6
1800	114.9	5.5	294.6	-10.6
1810	116.9	6.9	297.1	-10.6
1820	118.9	8.1	299.4	-10.6
1830	120.9	9.4	301.8	-10.7
1840	122.9	10.7	304.2	-10.7
1850	125.0	11.9	306.6	-10.7
1900	127.1	13.1	309.0	-10.7
1910	129.2	14.2	311.4	-10.8
1920	131.4	15.4	313.9	-10.8
1930	133.6	16.5	316.3	-10.8
1940	135.8	17.5	318.7	-10.8
1950	138.1	18.5	321.1	-10.9
2000	140.4	19.5	323.5	-10.9
2010	142.7	20.4	325.9	-10.9
2020	145.0	21.2	328.3	-10.9
2030	147.4	22.0	330.8	-11.0
2040	149.9	22.8	333.2	-11.0
2050	152.3	23.5	335.6	-11.0
2100	154.7	24.1	337.9	-11.1
2110	157.3	24.7	340.4	-11.1
2120	159.9	25.2	342.8	-11.1
2130	162.4	25.7	345.1	-11.1
2140	165.0	26.1	347.5	-11.1
2150	167.7	26.4	350.1	-11.1
2200	170.3	26.7	352.5	-11.2
2210	172.8	26.9	354.8	-11.2
2220	175.5	27.0	357.2	-11.2
2230	178.2	27.1	359.7	-11.2
2240	-179.1	27.0	2.0	-11.3
2250	-176.5	27.0	4.4	-11.3
2300	-173.8	26.8	6.8	-11.3
2310	-171.2	26.6	9.3	-11.4
2320	-168.6	26.3	11.7	-11.4
2330	-166.0	26.0	14.1	-11.4
2340	-163.4	25.5	16.5	-11.4
2350	-160.8	25.1	18.9	-11.5
2400	-158.3	24.5	21.3	-11.5