CALENDAR ALGORITHMS

There are several well known algorithms used for determining the day of the week for any date. The calendar programs included here are based on the following:

$$DOW = \sqrt[7]{INT\left(\frac{XY}{12}\right) + R + INT\left(\frac{R}{4}\right) + M + D + \left(6 - 2\left(\sqrt[4]{AB}\right)\right)}$$

where:
- DOW = day of week
- INT = the integral value of
- R = the remainder after the indicated division
- D = the day of the month
- XY = the last two digits of the year
- AB = the first two digits of the year
- 7 = modulus of the enclosed modular sum (means the same as "cast out sevens")
- 4 = denotes the modular value of the enclosed AB with 4 the modulus. (cast out fours)
- M = a month number from the table below

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	4	4	0	2	5	0	3	6	1	4	6

The algorithm above applies only to the Gregorian calendar which began on Friday, October 15, 1582. The ten days immediately previous were omitted from the calendar, the day just before being Thursday, October 4, 1582 in the Julian calendar.

Do not confuse the Julian calendar with Julian Day numbers which are used in H-P's CALENDAR FUNCTIONS program (80-04A). There is little or no relation between the two, in spite of the similarity of the names. The Julian calendar was established in the Roman empire by Julius Caesar with the advice of the astronomer Sosigenes to correct the confusion that had arisen between the year and the seasons. The year 46 B.C. was increased by intercalations to 445 days and his calendar was begun on 1-1-45 B.C. Due to the confusion resulting from it's adoption the intercalary days were incorrectly added until the error was corrected by Augustus Caesar in 8 B.C. who omitted further intercalations until A.D. 8. After 1-1-8 the calendar remained in this form until the Gregorian reform in 1582.

The Julian calendar assumed the year took 365.250 days and corrected the discrepancy by adding an extra day every fourth year. Since the exact value of the fractional part is .24219878 an error slowly accumulated until the reform in 1582. That last reform consisted of:

1. Dropping 10 days from the calendar (correcting the accumulated error)
2. Omitting the intercalary day in those century years not evenly divisible by 400. Thus 1700, 1800, 1900, 2100 etc. are not leap years but 1600, 2000 are.

In the sixteenth century Josephus Justus Scaliger in honour of his father Julian , introduced the continuous era known as the Julian period. It is a continuous succession of days--no years, no months. It began 1-1-4713 B.C. The Julian day begins at noon. Since all days are consecutively numbered, the obvious value to astronomers and others is to determine the elapsed days between two dates. Merely subtract the corresponding Julian day numbers. Tables and calculator programs are available to determine the Julian day number for any date in history or the future.

The program entitled Julian calendar computes the day of the week for any date in the period 1-1-8 to and including 10-4-1582. For reasons stated above it may be arranged back to 1-1-1. Be sure to enter a date such as 1-1-8 in this manner: 1.010008

FRIDAY 13th Rearranges the above algorithm to search the calendar for consecutive occurrences of a given week day on a given day of the month such as Fri 13th, Mon.1st etc.

CALENDAR SEARCH examines consecutive years for the occurrence of a given date on a given week day, such as Christmas on Sunday or July 4th on a Saturday. Expect to be surprised with Feb.29th on Sunday.

MOON PHASE-- For those not familiar with the jargon the little sketch below should serve to explain the "age" or phase of the moon :

FURTHER READING

Sky and Sextant. Practical Celestial Navitation, by John P. Sudlong, is a 1975 copyrighted book with a special chapter on the use of hand-held calculators. The SR-50, HP-35, HP-45. Van Nostrand Reinhold Co., 5-3/4 X 8-1/2", hard-bound, 151 pages.

STEP	KEY ENTRY 1	KEY CODE
1	LBL A	
	RCL I	
	4	
	+	
5	FRC	
	X=0?	
	GTO 2	
	GTO 3	
	LBL E	
10	SF 2	
	RCL I	
	4	
	0	
	0	
15	+	
	FRC	
	X=0?	
	GTO 4	
	GTO 2	
20	LBL 2	
	RCL I	
	EEX	
	2	
	+	
25	FRC	
	X=0?	
	GTO 4	
	GTO 3	
	LBL 4	
30	CF 2	
	GTO 3	
	LBL 3	
	RCL I	
	EEX	
35	2	
	÷	
	STO 9	
	INT	
	4	
40	+	
	FRC	
	9	
	X	
	6	
45	X≷Y	
	-	
	STO A	
	RCL 9	
49	FRC	
50	EEX	
	2	
	X	
	1	
	2	
55	+	
	STO 8	
	INT	
	STO 7	
	RCL 8	
60	FRC	
	1	
	2	
	X	
	STO+7	
65	4	
	+	
	RND	
	INT	
	STO+7	
70	RCL 2	
	STO 8	
	RCL A	
	STO+8	
	RCL 1	
75	1	
	X=Y?	
	GTO 8	
	RCL I	
	2	
80	X=Y?	
	GTO 0	
	GTO 5	
	LBL 0	
	RCL 2	
85	2	
	9	
	X=Y?	
	GTO 9	
	GTO C	
90	LBL 9	
	FS?	
	GTO 9	
	GTO 1	
	LBL 8	
95	GSB 7	
	GTO C	
	LBL 8	
	RCL 1	
	3	
100	X=Y?	

STEP	KEY ENTRY 2	KEY CODE
101	GTO C	
	RCL 1	
	4	
	X=Y?	
105	GTO D	
	RCL I	
	5	
	X=Y?	
	GTO E	
110	RCL I	
	6	
	X=Y?	
	GTO A	
	RCL I	
115	7	
	X=Y?	
	GTO D	
	RCL I	
	8	
120	X=Y?	
	GTO b	
	RCL I	
	9	
	X=Y?	
125	GTO c	
	RCL I	
	1	
	0	
	X=Y?	
130	GTO B	
	RCL I	
	1	
	1	
	X=Y?	
135	GTO C	
	GTO c	
	LBL B	
	1	
	STO+8	
140	FS?	
	GSB 7	
	GTO d	
	LBL C	
	4	
145	STO+8	
	FS?	
	GSB 7	
	GTO d	
149	LBL D	
150	0	
	STO+8	
	GTO d	
	LBL E	
	2	
155	STO+8	
	GTO d	
	LBL A	
	5	
	STO+8	
160	GTO d	
	LBL b	
	3	
	STO+8	
	GTO d	
165	LBL c	
	6	
	STO+8	
	GTO d	
	LBL d	
170	RCL 8	
	7	
	+	
	FRC	
	7	
175	X	
	STO 4	
	RCL 7	
	7	
	+	
180	FRC	
	7	
	X	
	RND	
	STO 5	
185	RCL 4	
	+	
	7	
	+	
	FRC	
190	7	
	X	
	RND	
	STO 6	
	RCL 3	
195	X=Y?	
	GTO a	
	GTO 1	
	LBL e	
	RCL 2	
200	EEX	

STEP	KEY ENTRY
201	2
	+
	RCL 1
	+
205	RCL I
	EEX
	4
	+
	+
210	PRT X
	GTO 1
	LBL 1
	1582
	GTO A
215	LBL 7
	1
	STO-8
	RTN
	R/S
220	
224	

1. CALENDAR SEARCH

BY: DAN M. FENSTERMACHER - 1438

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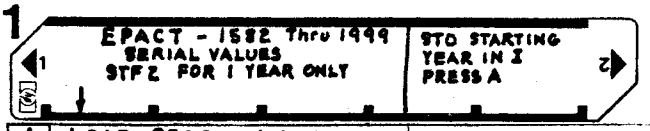
STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	LOAD PROGRAM CARD SIDES 1 & 2			
2	STORE STARTING YEAR IN I REGISTER.			
	STORE MONTH IN REG. 1 JAN.=1, FEB.=2 ETC.			
	STORE DAY OF MONTH IN REGISTER 2			
	STORE DAY OF WEEK IN REG. 3. SUN=1, -SAT=0			
3	PRESS A - OUTPUT IS SERIAL LIST OF YEARS HAVING THE GIVEN DATE ON THE GIVEN WEEK DAY.			MM.DDYYYY
	EXAMPLE: FEB. 29 OCCURS ON SUNDAY ONLY THREE TIMES IN THIS CENTURY.			THREE

1. EPACT

BY: DAN M. FENSTERMACHER - 1438



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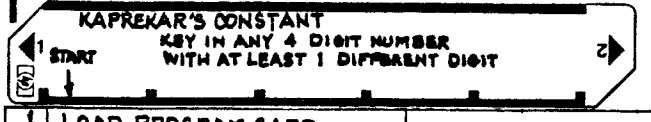
1	LOAD PROGRAM CARD SIDE 1 ONLY.			
2	STORE STARTING YEAR IN REGISTER I. SET FLAG 2 FOR 1 YEAR ONLY. PROGRAM PRINTS ERROR FOR YEARS PAST 1999, & IS INVALID FOR JULIAN ERA.		SEE PAGE 22 FOR PROGRAM LISTING (RIGHT SIDE)	
3	PRESS A. OUTPUT IS YEARS IN SERIAL ORDER FOLLOWED BY EPACT FOR EACH YEAR			YEAR EPACT SPC.
	THE EPACT IS DEFINED AS THE AGE OF THE MOON LESS 1 DAY ON JAN. 1 OF EACH YEAR IN THE ECCLESIACTICAL LUNAR CALENDAR. SEE TEXT.			MOON

1. KAPREKAR'S CONSTANT

BY: DAN M. FENSTERMACHER - 1438



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1	LOAD PROGRAM CARD - SIDES 1 & 2		
2	KEY IN ANY 4 DIGIT NUMBER WITH AT LEAST ONE DIGIT DIFFERENT FROM THE REST. EXAMPLES: 0001, 9366, 8881 ETC.		SEE PAGE 22 FOR PROGRAM LISTING (LEFT SIDE)
3	PRESS A. OUTPUT IS INPUT NUMBER ARRANGED IN DESCENDING ORDER, THEN IN ASCENDING ORDER - THE TWO SUBTRACTED AND THE PROCEDURE REPEATED UPON THE REMAINDER FOR UP TO 9 ITERATIONS UNTIL A REPEATING CONSTANT IS OBTAINED. PROGRAM HALTS WHEN CONSTANT 6174 IS OBTAINED.		

CALENDAR SEARCH

```
001 f LBL A   31 25 11
002 0         00
003 STO 8     33 08
004 h CF 1    35 61 01
005 f LBL B   31 25 12
006 h CF 0    35 61 00
007 2         02
008 RCL 1     34 01
009 g X≤Y?    32 71
010 h SF 0    35 51 00
011 RCL 1     34 01
012 RCL 2     34 02
013 STO 6     33 06
014 x         71
015 5         05
016 8         08
017 g X=Y?    32 51
018 h SF 2    35 51 02
019 h RCL I   35 34
020 1         01
021 f %       31 82
022 STO 0     33 00
023 2         02
024 5         05
025 x         71
026 STO 9     33 09
027 g FRAC    32 83
028 f X≠0?    31 61
029 GTO 1     22 01
030 RCL 0     34 00
031 g FRAC    32 83
032 f X=0?    31 51
033 GTO D     22 14
034 RCL 9     34 09
035 g FRAC    32 83
036 f X=0?    31 51
037 GTO E     22 15
038 GTO 1     22 01
039 f LBL D   31 25 14
040 RCL 0     34 00
041 f INT     31 83
042 4         04
043 ÷         81
044 g FRAC    32 83
045 f X≠0?    31 61
046 GTO 1     22 01
047 f LBL E   31 25 15
048 h CF 2    35 61 02
049 h F? 0    35 71 00
050 GTO 0     22 00
051 GTO 1     22 01
052 f LBL 0   31 25 00
053 6         06
054 STO+6     33 61 06
055 f LBL 1   31 25 01
056 h F? 2    35 71 02
057 GTO C     22 13
058 RCL 0     34 00
059 g FRAC    32 83
060 EEX       43
061 2         02
062 x         71
063 1         01
064 2         02
065 ÷         81
066 STO 5     33 05
067 f INT     31 83
068 f RND     31 24
069 STO+6     33 61 06
070 RCL 5     34 05
071 g FRAC    32 83
072 1         01
073 2         02
074 x         71
075 STO+6     33 61 06
076 4         04
077 ÷         81
078 DSP 3     23 03
079 f RND     31 24
080 f INT     31 83
081 STO+6     33 61 06
082 RCL 0     34 00
083 f INT     31 83
084 4         04
085 ÷         81
086 g FRAC    32 83
087 8         08
088 x         71
089 6         06
090 h X ↔ Y   35 52
091 -         51
092 STO+6     33 61 06
093 h F? 1    35 71 01
094 GTO 2     22 02
095 h RCL I   35 34
096 STO 5     33 05
097 f P ↔ S   31 42
098 6         06
099 STO C     33 13
100 STO 9     33 09
101 5         05
102 STO 6     33 06
103 4         04
104 STO B     33 12
105 STO 3     33 03
106 STO 2     33 02
107 3         03
108 STO 8     33 08
109 2         02
110 STO 5     33 05
111 1         01
112 STO A     33 11
113 STO 1     33 01
114 0         00
115 STO 3     33 03
116 STO 4     33 04
117 f P ↔ S   31 42
118 2         02
119 2         02
120 h STO I   35 33
121 RCL 1     34 01
122 1         01
123 0         00
124 +         61
125 STO 7     33 07
126 g LBLf C  32 25 13
127 h RCL I   35 34
128 RCL 7     34 07
129 g X=Y?    32 51
130 GTO f d   22 31 14
131 f DSZ     31 33
132 GTO f c   22 31 13
133 g LBLf d  32 25 14
134 RCL (i)   34 24
135 STO 8     33 08
136 h CF 1    35 61 01
137 STO+6     33 61 06
138 RCL 5     34 05
139 h STO I   35 33
140 f LBL 2   31 25 02
141 RCL 8     34 08
142 RCL 6     34 06
143 h F? 1    35 71 01
144 +         61
145 7         07
146 ÷         81
147 g FRAC    32 83
148 7         07
149 x         71
150 DSP 3     23 03
151 f RND     31 24
152 h SF 1    35 51 01
153 RCL 3     34 03
154 g X≠Y?    32 61
155 GTO C     22 13
156 f LBL B   31 25 12
157 h RCL I   35 34
158 EEX       43
159 6         06
160 ÷         81
161 DSP 6     23 06
162 RCL 2     34 02
163 1         01
164 f %       31 82
165 h X ↔ Y   35 52
166 h R↓      35 53
167 +         61
168 RCL 1     34 01
169 +         61
170 DSP 6     23 06
171 f -x-     31 84
172 f LBL C   31 25 13
173 f ISZ     31 34
174 GTO B     22 12
```