

Chapter 4 – COMPUTING THE JULIAN DAY & TIME

Variable star observations reported to the AAVSO should always be expressed in terms of the **Julian Day (JD)** and the decimal part of the day given in **Greenwich Mean Astronomical Time (GMAT)**. This is the standard unit of time used by astronomers because it is convenient and unambiguous. Here are the advantages:

— The astronomical day runs from noon to noon so that you don't have to change calendar dates in the middle of the night.

— A single number represents days, months, years, hours, and minutes.

— Data on the same star from people observing anywhere in the world can be compared easily since they are all relative to the same time zone; that of the prime meridian in Greenwich, England.

What follows is a simple procedure for figuring the JD and GMAT decimal of your observations.

Step-by-Step Instructions

1. Record the astronomical time and date of your observation as **counted from local noon**. Use the 24-hour clock instead of AM or PM.

examples:

- A. June 3 at 9:34 PM = June 3 at 9:34
- B. June 4 at 4:16 AM = June 3 at 16:16

Note that the date of your observation does not change after midnight because an astronomical day runs from noon to noon *not* midnight to midnight.

2. If your observation was made when Daylight Savings Time (Summer Time) is in effect where you live, subtract one hour to get standard time.
 - A. June 3 at 9:34 DST = June 3 at 8:34
 - B. June 3 at 16:16 DST = June 3 at 15:16
3. Figure the Julian Date equivalent to the astronomical calendar date of your observation as determined in Step 1 above

using the JD calendar shown in Figure 4.1.

A and B: June 3, 2005 = 2,453,525

4. Find the decimal equivalent of the hours and minutes of your observation from Table 4.1 and add the result to the JD integer found above. Notice that this table also takes into account your longitude (and thus time zone) so that the end result is expressed in GMAT.

Using the excerpt from Table 4.1 below, you can see that if you observed from the 15°E time zone, the GMAT decimal equivalent of 8:34 is .3. For the observation made at 15:16, it would be .6.

	Greenwich 0°	Middle European 15°E	Turkey 30°E
0.0			
0.1	3:36	4:36	5:36
0.2	6:01	7:01	8:01
0.3	8:24	9:24	10:24
0.4	10:49	11:49	12:49
0.5	13:12	14:12	15:12
0.6	15:37	16:37	17:37
0.7	18:00	19:00	20:00

Now add the decimal to the JD integer determined in Step 3 to arrive at the final result of:

- A. JD = 2453525.3
- B. JD = 2453525.6

On the following page are several examples of conversion from local time to JD/GMAT. It is recommended that you work through each case until you feel very comfortable with the procedure. Remember that recording the proper date and time for each of your observations is absolutely essential!

Sample Calculations

Example 1 – Observation from Cambridge, MA, USA (75°W time zone) at 9:40 pm Eastern Daylight Time, June 22, 2005

Step 1: astronomical time = 9:40, June 22, 2005

Step 2: 9:40 - 1 = 8:40 on June 22, 2005

Step 3: JD = 2,453,544

Step 4: GMAT decimal = .6

Final result: 2,453,544.6

Example 2 – Observation from Tokyo, Japan (135°E) at 1:15 am, January 10, 2005

Step 1: astronomical time = 13:15, Jan. 9, 2005

Step 2: N/A

Step 3: JD = 2,453,380

Step 4: GMAT decimal = .2

Final Result: 2,453,380.2

Example 3 – Observation from Vancouver, BC Canada (120°W) at 5:21 am, February 14, 2005

Step 1: astronomical time = 17:21, Feb. 13, 2005

Step 2: N/A

Step 3: JD = 2,453,415

Step 4: GMAT decimal = 1.1 (add 1 day)

Final Result: 2,453,416.1

Example 4 – Observation from Auckland, New Zealand (180°E) at 8:25 pm, April 28, 2005

Step 1: astronomical time = 8:25, Apr.28, 2005

Step 2: N/A

Step 3: JD = 2,453,489

Step 4: GMAT decimal = -0.9 (subtract 1 day)

Final Result: 2,453,488.9

Note that as shown in example 4, if the time you observe is exactly the same as a time listed in Table 4.1, you should choose the larger of the two decimals.

The calendar on page 27 is representative of the one mailed out to AAVSO observers each year. It gives the last four digits of the Julian Day for each day of every month of the year 2005 (On the actual calendar, the months July–December are on the reverse side). For the complete JD, add 2,450,000 to the four digit value given in the calendar for the *Astronomical Day* of your observation.

Some observers prefer to create their own computer programs or use existing ones to calculate JD. An online JD calendar can be found on the AAVSO website (<http://www.aavso.org/observing/aids/jdcalendar.shtml>).

Where does JD come from?

In the Julian Day system, all days are numbered consecutively from Julian Day zero, which began at noon on January 1, 4713 BC. Joseph Justus Scaliger, a French classical scholar of the 16th century, determined this as the date on which three important cycles coincided; the 28-year solar cycle, the 19-year lunar cycle, and the 15-year cycle of tax assessment called the “Roman Indiction”.

UT, GMT, and GMAT

Often in astronomy you will see the time of events being expressed in Universal Time (or UT). This is the same as Greenwich Mean Time (GMT) which starts at midnight in Greenwich, England. To find the UT equivalent of a specific time, simply add to it, or subtract from it, as the case may be, the zone difference for your observing location. The “World Map of Time Zones” (Figure 4.2) is provided to help you to determine the zone difference for your location. To convert from UT to Greenwich Mean *Astronomical Time* (GMAT) subtract 12 hours.

Two additional reference tables are provided in this chapter for your convenience:

Table 4.2 lists the JDs for the zero day of each month from 1996 to 2025. The zero day (which is actually the last day of the previous month) is used for ease in calculating the JD of any given day by making it possible to simply add the calendar date to the JD listed.

example: Jan. 28, 2005
= (JD for Jan 0) + 28
= 2453371+28
= 2453399

Table 4.3 can be used to find the GMAT decimal of the day to four decimal places. This degree of accuracy is only needed for certain types of stars (see Table 6.1, page 43).

Figure 4.1 – Sample JD Calendar

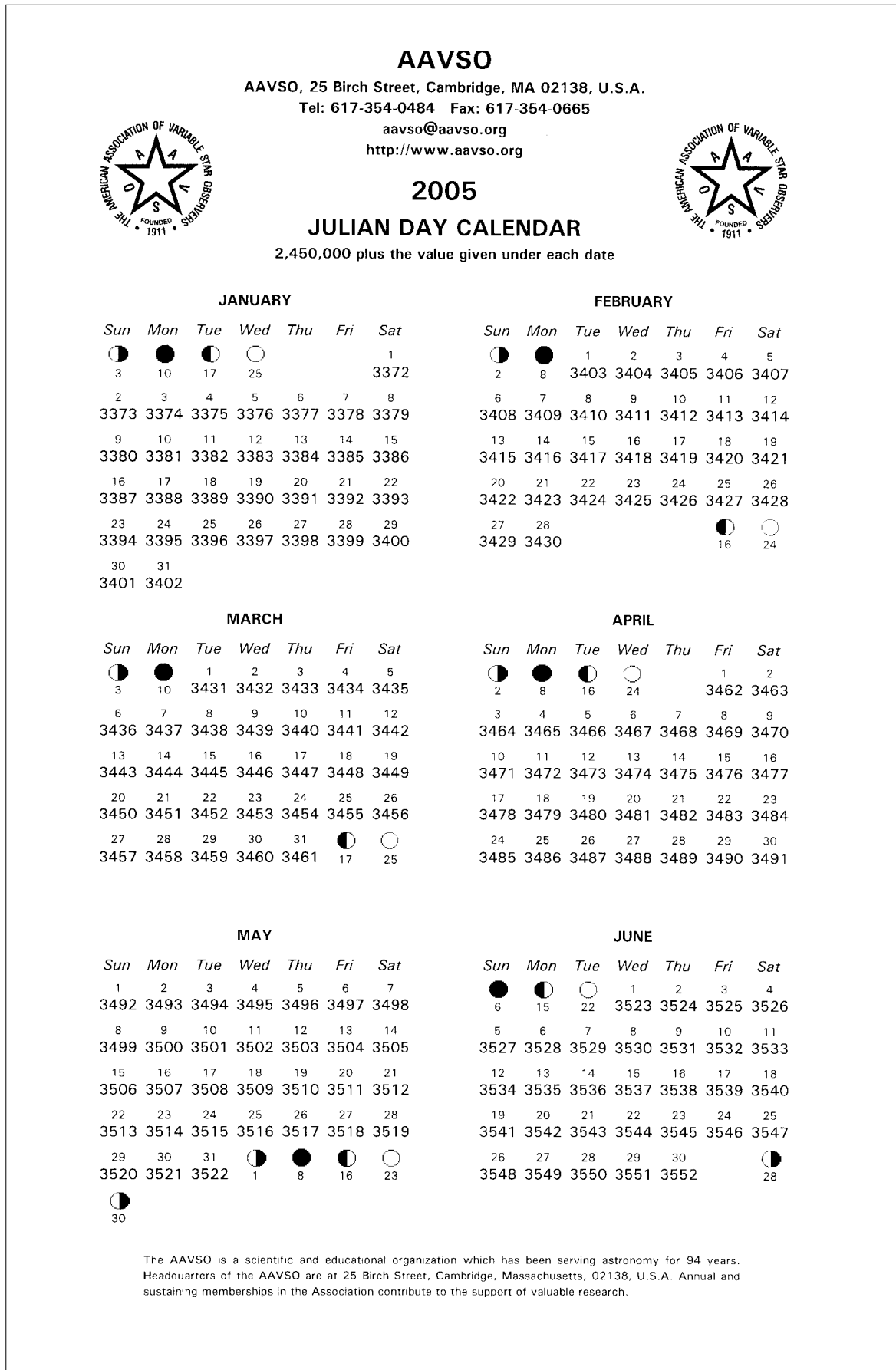
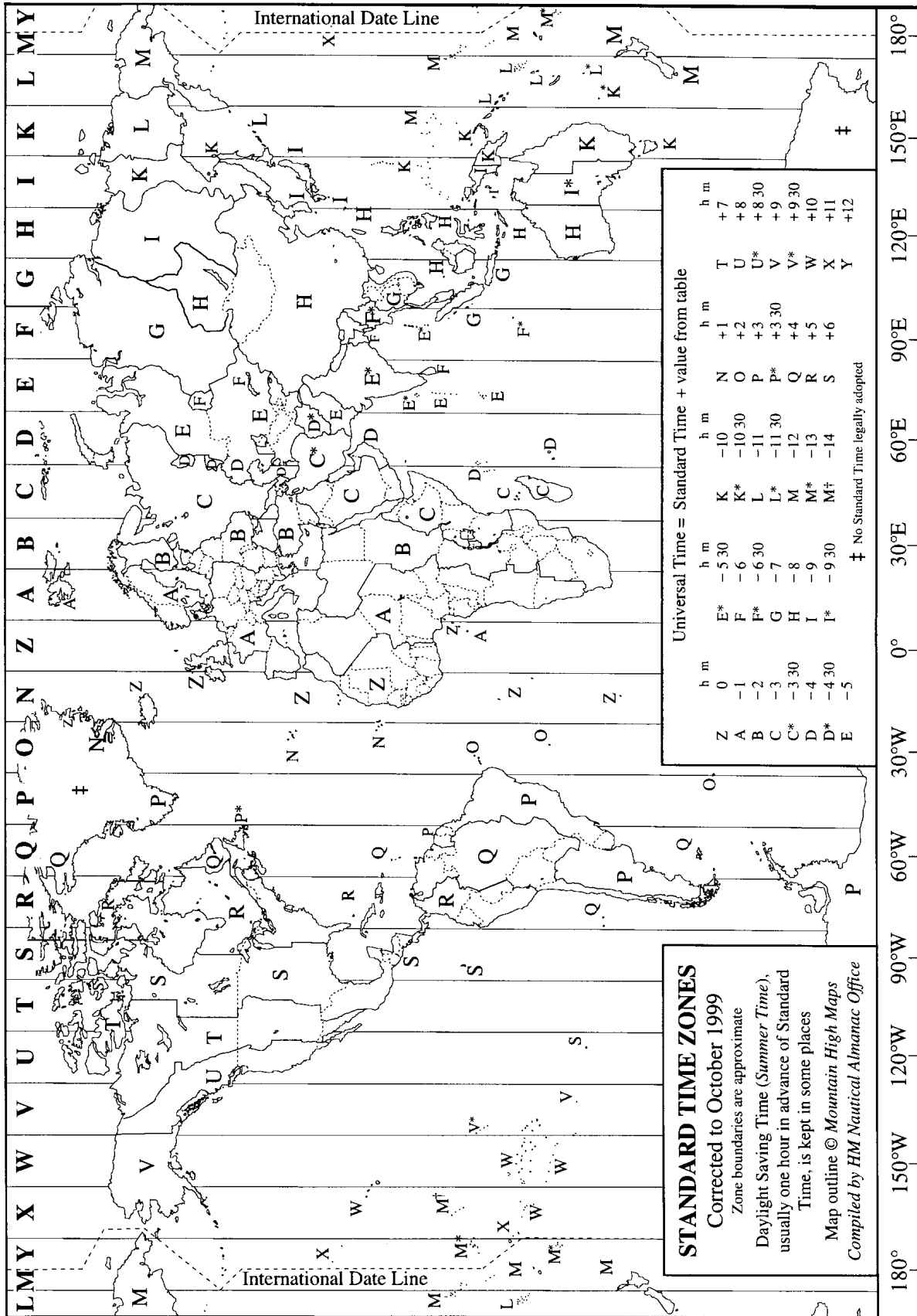


Figure 4.2 – World Map of Time Zones



“World Map of Time Zones” produced by HM Nautical Almanac Office Copyright Council for the Central Laboratory of the Research Councils. Reproduced with their permission.

Table 4.1 – *JD Decimal of the Day* This chart can be used to convert into a tenth of a day, the time at which an observation is made, expressed in Greenwich Mean Astronomical Time. To use it, find the longitude that best describes the time zone of your observing location, then move down the column until you find the two times that bracket the time of your observation (i.e. one time is earlier and the next time going down the table is later than your observation). Now follow the row across to the left and record the decimal number. This will be added to the JD integer for the date of your observation. If the time of your observation is exactly the same as one of the times given on the table, take the larger of the decimal numbers that bracket it.

		West Longitude												
		Greenwich	Iceland	Azores	Rio de Janeiro	Atlantic	Eastern	Central	Mountain	Pacific	Yukon	Alaskan	Aleutian	International Date Line
		0°	15°W	30°W	45°W	60°W	75°W	90°W	105°W	120°W	135°W	150°W	165°W	180°W
0.1		3:36	2:36											
0.2		6:01	5:01	4:01	3:01									
0.3		8:24	7:24	6:24	5:24	4:24	3:24	2:24						
0.4		10:49	9:49	8:49	7:49	6:49	5:49	4:49	3:49	2:49				
0.5		13:12	12:12	11:12	10:12	9:12	8:12	7:12	6:12	5:12	4:12	3:12	2:12	
0.6		15:37	14:37	13:37	12:37	11:37	10:37	9:37	8:37	7:37	6:37	5:37	4:37	3:37
0.7		18:00	17:00	16:00	15:00	14:00	13:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00
0.8		20:25	19:25	18:25	17:25	16:25	15:25	14:25	13:25	12:25	11:25	10:25	9:25	8:25
0.9														
0.0			21:48	20:48	19:48	18:48	17:48	16:48	15:48	14:48	13:48	12:48	11:48	10:48
0.1					22:13	21:13	20:13	19:13	18:13	17:13	16:13	15:13	14:13	13:13
0.2							22:36	21:36	20:36	19:36	18:36	17:36	16:36	15:36
0.3										22:01	21:01	20:01	19:01	18:01

For times below this line, **add one day** plus the decimal on the left to the JD.

		East Longitude												
		Greenwich	Middle European	Turkey	Iraq	Oman	Omsk	Tibet	Thailand	Philippines	Japan	New South Wales	Wake Island	New Zealand
		0°	15°E	30°E	45°E	60°E	75°E	90°E	105°E	120°E	135°E	150°E	165°E	180°E
0.6														
0.7													2:37	3:37
0.8											3:00	4:00	5:00	6:00
0.9									3:25	4:25	5:25	6:25	7:25	8:25
0.0							3:48	4:48	5:48	6:48	7:48	8:48	9:48	10:48
0.1				3:13	4:13	5:13	6:13	7:13	8:13	9:13	10:13	11:13	12:13	13:13
0.2		3:36	4:36	5:36	6:36	7:36	8:36	9:36	10:36	11:36	12:36	13:36	14:36	15:36
0.3		6:01	7:01	8:01	9:01	10:01	11:01	12:01	13:01	14:01	15:01	16:01	17:01	18:01
0.4		8:24	9:24	10:24	11:24	12:24	13:24	14:24	15:24	16:24	17:24	18:24	19:24	20:24
0.5		10:49	11:49	12:49	13:49	14:49	15:49	16:49	17:49	18:49	19:49	20:49	21:49	22:49
0.6		13:12	14:12	15:12	16:12	17:12	18:12	19:12	20:12	21:12	22:12			
0.7		15:37	16:37	17:37	18:37	19:37	20:37	21:37						
0.8		18:00	19:00	20:00	21:00									
0.9		20:25	21:25											

For times above this line, **subtract one day** from the JD, then add the decimal to the left.

Table 4.2 – Julian Day Number 1996–2025

To use this table, add the calendar date (based on the noon to noon astronomical time) of your observation to the zero day of the appropriate month for the desired year. For example, for an observation made on February 6, 2015, the Julian date would be: 2457054 + 6 = 2457060.

Year	Jan 0	Feb 0	Mar 0	Apr 0	May 0	Jun 0	Jul 0	Aug 0	Sep 0	Oct 0	Nov 0	Dec 0
1996	2450083	2450114	2450143	2450174	2450204	2450235	2450265	2450296	2450327	2450357	2450388	2450418
1997	2450449	2450480	2450508	2450539	2450569	2450600	2450630	2450661	2450692	2450722	2450753	2450783
1998	2450814	2450845	2450873	2450904	2450934	2450965	2450995	2451026	2451057	2451087	2451118	2451148
1999	2451179	2451210	2451238	2451269	2451299	2451330	2451360	2451391	2451422	2451452	2451483	2451513
2000	2451544	2451575	2451604	2451635	2451665	2451696	2451726	2451757	2451788	2451818	2451849	2451879
2001	2451910	2451941	2451969	2452000	2452030	2452061	2452091	2452122	2452153	2452183	2452214	2452244
2002	2452275	2452306	2452334	2452365	2452395	2452426	2452456	2452487	2452518	2452548	2452579	2452609
2003	2452640	2452671	2452699	2452730	2452760	2452791	2452821	2452852	2452883	2452913	2452944	2452974
2004	2453005	2453036	2453065	2453096	2453126	2453157	2453187	2453218	2453249	2453279	2453310	2453340
2005	2453371	2453402	2453430	2453461	2453491	2453522	2453552	2453583	2453614	2453644	2453675	2453705
2006	2453736	2453767	2453795	2453826	2453856	2453887	2453917	2453948	2453979	2454009	2454040	2454070
2007	2454101	2454132	2454160	2454191	2454221	2454252	2454282	2454313	2454344	2454374	2454405	2454435
2008	2454466	2454497	2454526	2454557	2454587	2454618	2454648	2454679	2454710	2454740	2454771	2454801
2009	2454832	2454863	2454891	2454922	2454952	2454983	2455013	2455044	2455075	2455105	2455136	2455166
2010	2455197	2455228	2455256	2455287	2455317	2455348	2455378	2455409	2455440	2455470	2455501	2455531
2011	2455562	2455593	2455621	2455652	2455682	2455713	2455743	2455774	2455805	2455835	2455866	2455896
2012	2455927	2455958	2455987	2456018	2456048	2456079	2456109	2456140	2456171	2456201	2456232	2456262
2013	2456293	2456324	2456352	2456383	2456413	2456444	2456474	2456505	2456536	2456566	2456597	2456627
2014	2456658	2456689	2456717	2456748	2456778	2456809	2456839	2456870	2456901	2456931	2456962	2456992
2015	2457023	2457054	2457082	2457113	2457143	2457174	2457204	2457235	2457266	2457296	2457327	2457357
2016	2457388	2457419	2457448	2457479	2457509	2457540	2457570	2457601	2457632	2457662	2457693	2457723
2017	2457754	2457785	2457813	2457844	2457874	2457905	2457935	2457966	2457997	2458027	2458058	2458088
2018	2458119	2458150	2458178	2458209	2458239	2458270	2458300	2458331	2458362	2458392	2458423	2458453
2019	2458484	2458515	2458543	2458574	2458604	2458635	2458665	2458696	2458727	2458757	2458788	2458818
2020	2458849	2458880	2458909	2458940	2458970	2459001	2459031	2459062	2459093	2459123	2459154	2459184
2021	2459215	2459246	2459274	2459305	2459335	2459366	2459396	2459427	2459458	2459488	2459519	2459549
2022	2459580	2459611	2459639	2459670	2459700	2459731	2459761	2459792	2459823	2459853	2459884	2459914
2023	2459945	2459976	2460004	2460035	2460065	2460096	2460126	2460157	2460188	2460218	2460249	2460279
2024	2460310	2460341	2460370	2460401	2460431	2460462	2460492	2460523	2460554	2460584	2460615	2460645
2025	2460676	2460707	2460735	2460766	2460796	2460827	2460857	2460888	2460919	2460949	2460980	2461010

Table 4.3 – *JD Decimal (to four places)* To use this table, find the **GMAT** hours across the top of the page and the minutes down the side. The result is the fraction of the day represented. GMAT is explained on page 26 of this manual.

GMAT	0h	1h	2h	3h	4h	5h	6h	7h	8h	9h	10h	11h	12h	13h	14h	15h	16h	17h	18h	19h	20h	21h	22h	23h	
0	0.0000	0.0417	0.0833	0.1250	0.1667	0.2083	0.2500	0.2917	0.3333	0.3750	0.4167	0.4583	0.5000	0.5417	0.5833	0.6250	0.6667	0.7083	0.7500	0.7917	0.8333	0.8750	0.9167	0.9583	1.0000
1	0.0007	0.0424	0.0840	0.1257	0.1674	0.2090	0.2507	0.2924	0.3340	0.3757	0.4174	0.4590	0.5007	0.5424	0.5840	0.6257	0.6674	0.7090	0.7507	0.7924	0.8340	0.8757	0.9174	0.9590	1.0007
2	0.0014	0.0431	0.0847	0.1264	0.1681	0.2097	0.2514	0.2931	0.3347	0.3764	0.4181	0.4597	0.5014	0.5431	0.5847	0.6264	0.6681	0.7097	0.7514	0.7931	0.8347	0.8764	0.9181	0.9597	1.0014
3	0.0021	0.0437	0.0854	0.1271	0.1688	0.2104	0.2521	0.2938	0.3354	0.3771	0.4188	0.4604	0.5021	0.5437	0.5854	0.6271	0.6687	0.7104	0.7521	0.7937	0.8354	0.8771	0.9187	0.9604	1.0021
4	0.0028	0.0444	0.0861	0.1278	0.1694	0.2111	0.2528	0.2944	0.3361	0.3778	0.4194	0.4611	0.5028	0.5444	0.5861	0.6278	0.6694	0.7111	0.7528	0.7944	0.8361	0.8778	0.9194	0.9611	1.0028
5	0.0035	0.0451	0.0868	0.1285	0.1701	0.2118	0.2535	0.2951	0.3368	0.3785	0.4201	0.4618	0.5035	0.5451	0.5868	0.6285	0.6701	0.7118	0.7535	0.7951	0.8368	0.8785	0.9201	0.9618	1.0035
6	0.0042	0.0458	0.0875	0.1292	0.1708	0.2125	0.2542	0.2958	0.3375	0.3792	0.4208	0.4625	0.5042	0.5458	0.5875	0.6292	0.6708	0.7125	0.7542	0.7958	0.8375	0.8792	0.9208	0.9625	1.0042
7	0.0049	0.0465	0.0882	0.1299	0.1715	0.2132	0.2549	0.2965	0.3382	0.3800	0.4215	0.4632	0.5049	0.5465	0.5882	0.6299	0.6715	0.7132	0.7549	0.7965	0.8382	0.8800	0.9215	0.9632	1.0049
8	0.0056	0.0472	0.0889	0.1306	0.1722	0.2139	0.2556	0.2972	0.3389	0.3806	0.4222	0.4639	0.5056	0.5472	0.5889	0.6306	0.6722	0.7139	0.7556	0.7972	0.8389	0.8806	0.9222	0.9639	1.0056
9	0.0063	0.0479	0.0896	0.1313	0.1729	0.2146	0.2563	0.2979	0.3396	0.3813	0.4229	0.4646	0.5063	0.5479	0.5896	0.6313	0.6729	0.7146	0.7563	0.7979	0.8396	0.8813	0.9229	0.9646	1.0063
10	0.0069	0.0486	0.0903	0.1320	0.1736	0.2153	0.2570	0.2986	0.3403	0.3819	0.4236	0.4653	0.5070	0.5486	0.5903	0.6320	0.6736	0.7153	0.7570	0.7986	0.8403	0.8820	0.9236	0.9653	1.0069
11	0.0076	0.0493	0.0910	0.1327	0.1743	0.2160	0.2577	0.2993	0.3410	0.3826	0.4243	0.4660	0.5077	0.5493	0.5910	0.6327	0.6743	0.7160	0.7577	0.7993	0.8410	0.8827	0.9243	0.9660	1.0076
12	0.0083	0.0500	0.0917	0.1333	0.1750	0.2167	0.2583	0.3000	0.3417	0.3833	0.4250	0.4667	0.5083	0.5500	0.5917	0.6334	0.6750	0.7167	0.7583	0.8000	0.8417	0.8833	0.9250	0.9667	1.0083
13	0.0090	0.0507	0.0924	0.1340	0.1757	0.2174	0.2590	0.3007	0.3424	0.3840	0.4257	0.4674	0.5090	0.5507	0.5924	0.6340	0.6757	0.7174	0.7590	0.8007	0.8424	0.8840	0.9257	0.9674	1.0090
14	0.0097	0.0514	0.0931	0.1347	0.1764	0.2181	0.2597	0.3014	0.3431	0.3847	0.4264	0.4681	0.5097	0.5514	0.5931	0.6347	0.6764	0.7181	0.7597	0.8014	0.8431	0.8847	0.9264	0.9681	1.0097
15	0.0104	0.0521	0.0938	0.1354	0.1771	0.2188	0.2604	0.3021	0.3438	0.3854	0.4271	0.4688	0.5104	0.5521	0.5938	0.6354	0.6771	0.7188	0.7604	0.8021	0.8438	0.8854	0.9271	0.9688	1.0104
16	0.0111	0.0528	0.0944	0.1361	0.1778	0.2194	0.2611	0.3028	0.3444	0.3861	0.4278	0.4694	0.5111	0.5528	0.5944	0.6361	0.6778	0.7194	0.7611	0.8028	0.8444	0.8861	0.9278	0.9694	1.0111
17	0.0118	0.0535	0.0951	0.1368	0.1785	0.2201	0.2618	0.3035	0.3451	0.3868	0.4285	0.4701	0.5118	0.5535	0.5951	0.6368	0.6785	0.7201	0.7618	0.8035	0.8451	0.8868	0.9285	0.9701	1.0118
18	0.0125	0.0542	0.0958	0.1375	0.1792	0.2208	0.2625	0.3042	0.3458	0.3875	0.4292	0.4708	0.5125	0.5542	0.5958	0.6375	0.6792	0.7208	0.7625	0.8042	0.8458	0.8875	0.9292	0.9708	1.0125
19	0.0132	0.0549	0.0965	0.1382	0.1799	0.2215	0.2632	0.3049	0.3465	0.3882	0.4299	0.4715	0.5132	0.5549	0.5965	0.6382	0.6799	0.7215	0.7632	0.8049	0.8465	0.8882	0.9299	0.9715	1.0132
20	0.0139	0.0556	0.0972	0.1389	0.1806	0.2222	0.2639	0.3056	0.3472	0.3889	0.4306	0.4722	0.5139	0.5556	0.5972	0.6389	0.6806	0.7222	0.7639	0.8056	0.8472	0.8889	0.9306	0.9722	1.0139
21	0.0146	0.0563	0.0979	0.1396	0.1812	0.2229	0.2646	0.3063	0.3479	0.3896	0.4313	0.4729	0.5146	0.5563	0.5979	0.6396	0.6813	0.7229	0.7646	0.8063	0.8479	0.8896	0.9313	0.9729	1.0146
22	0.0153	0.0569	0.0986	0.1403	0.1819	0.2236	0.2653	0.3069	0.3486	0.3903	0.4319	0.4736	0.5153	0.5569	0.5986	0.6403	0.6819	0.7236	0.7653	0.8069	0.8486	0.8903	0.9319	0.9736	1.0153
23	0.0160	0.0576	0.0993	0.1410	0.1826	0.2243	0.2660	0.3076	0.3493	0.3910	0.4326	0.4743	0.5160	0.5576	0.5993	0.6410	0.6826	0.7243	0.7660	0.8076	0.8493	0.8910	0.9326	0.9743	1.0160
24	0.0167	0.0583	0.1000	0.1417	0.1833	0.2250	0.2667	0.3083	0.3500	0.3917	0.4333	0.4750	0.5167	0.5583	0.6000	0.6417	0.6833	0.7250	0.7667	0.8083	0.8500	0.8917	0.9333	0.9750	1.0167
25	0.0174	0.0590	0.1007	0.1424	0.1840	0.2257	0.2674	0.3090	0.3507	0.3924	0.4340	0.4757	0.5174	0.5590	0.6007	0.6424	0.6840	0.7257	0.7674	0.8090	0.8507	0.8924	0.9340	0.9757	1.0174
26	0.0181	0.0597	0.1014	0.1431	0.1847	0.2264	0.2681	0.3097	0.3514	0.3931	0.4347	0.4764	0.5181	0.5597	0.6014	0.6431	0.6847	0.7264	0.7681	0.8097	0.8514	0.8931	0.9347	0.9764	1.0181
27	0.0187	0.0604	0.1021	0.1437	0.1854	0.2271	0.2688	0.3104	0.3521	0.3937	0.4354	0.4771	0.5188	0.5604	0.6021	0.6438	0.6854	0.7271	0.7688	0.8104	0.8521	0.8938	0.9354	0.9771	1.0187
28	0.0194	0.0611	0.1028	0.1444	0.1861	0.2278	0.2694	0.3111	0.3528	0.3944	0.4361	0.4778	0.5194	0.5611	0.6028	0.6444	0.6861	0.7278	0.7694	0.8111	0.8528	0.8944	0.9361	0.9778	1.0194
29	0.0201	0.0618	0.1035	0.1451	0.1868	0.2285	0.2701	0.3118	0.3535	0.3951	0.4368	0.4785	0.5201	0.5618	0.6035	0.6451	0.6868	0.7285	0.7701	0.8118	0.8535	0.8951	0.9368	0.9785	1.0201
30	0.0208	0.0625	0.1042	0.1458	0.1875	0.2292	0.2708	0.3125	0.3542	0.3958	0.4375	0.4792	0.5208	0.5625	0.6042	0.6458	0.6875	0.7292	0.7708	0.8125	0.8542	0.8958	0.9375	0.9792	1.0208
31	0.0215	0.0632	0.1049	0.1465	0.1882	0.2299	0.2715	0.3132	0.3549	0.3965	0.4382	0.4799	0.5215	0.5632	0.6049	0.6465	0.6882	0.7299	0.7715	0.8132	0.8549	0.8965	0.9382	0.9799	1.0215
32	0.0222	0.0639	0.1056	0.1472	0.1889	0.2306	0.2722	0.3139	0.3556	0.3972	0.4389	0.4806	0.5222	0.5639	0.6056	0.6472	0.6889	0.7306	0.7722	0.8139	0.8556	0.8972	0.9389	0.9806	1.0222
33	0.0229	0.0646	0.1063	0.1479	0.1896	0.2313	0.2729	0.3146	0.3563	0.3979	0.4396	0.4813	0.5229	0.5646	0.6063	0.6479	0.6896	0.7313	0.7729	0.8146	0.8563	0.8979	0.9396	0.9813	1.0229
34	0.0236	0.0653	0.1069	0.1486	0.1903	0.2320	0.2736	0.3153	0.3569	0.3986	0.4403	0.4819	0.5236	0.5653	0.6069	0.6486	0.6903	0.7319	0.7736	0.8153	0.8569	0.8986	0.9403	0.9819	1.0236
35	0.0243	0.0660	0.1076	0.1493	0.1910	0.2327	0.2743	0.3160	0.3576	0.3993	0.4410	0.4826	0.5243	0.5660	0.6076	0.6493	0.6910	0.7326	0.7743	0.8160	0.8576	0.8993	0.9410	0.9826	1.0243
36	0.0250	0.0667	0.1083	0.1500	0.1917	0.2333	0.2750	0.3167	0.3583	0.4000	0.4417	0.4833	0.5250	0.5667	0.6083	0.6500	0.6917	0.7333	0.7750	0.8167	0.8583	0.9000	0.9417	0.9833	1.0250
37	0.0257	0.0674	0.1090	0.1507	0.1924	0.2340	0.2757	0.3174	0.3590	0.4007	0.4424	0.4840	0.5257	0.5674	0.6090	0.6507	0.6924	0.7340	0.7757	0.8174	0.8590	0.9007	0.9424	0.9840	1.0257
38	0.0264	0.0681	0.1097	0.																					

