

TABLAS DECLINACIÓN (grados), DISTANCIA RELATIVA INVERSA y ECUACIÓN DE TIEMPO (minutos)
 CALCULADAS SEGÚN LAS FÓRMULAS DE SPENCER
 (M. Iqbal, An Introduction to Solar Radiation, Academic Press (1983))



DIA MES	ENERO / FEBRERO				MARZO / ABRIL				MAYO / JUNIO				JULIO / AGOSTO			
	J	δ (°)	d_r	E_r (min)	J	δ (°)	d_r	E_r (min)	J	δ (°)	d_r	E_r (min)	J	δ (°)	d_r	E_r (min)
1	1	-23.06	1.0351	-2.90	60	-7.88	1.0190	-12.91	121	14.83	0.9845	3.02	182	23.18	0.9666	-3.46
2	2	-22.98	1.0351	-3.35	61	-7.50	1.0185	-12.73	122	15.13	0.9840	3.15	183	23.11	0.9666	-3.66
3	3	-22.89	1.0351	-3.79	62	-7.12	1.0179	-12.54	123	15.43	0.9835	3.27	184	23.04	0.9666	-3.86
4	4	-22.80	1.0351	-4.23	63	-6.73	1.0174	-12.35	124	15.73	0.9830	3.38	185	22.96	0.9666	-4.05
5	5	-22.70	1.0351	-4.67	64	-6.35	1.0169	-12.14	125	16.02	0.9825	3.48	186	22.88	0.9666	-4.24
6	6	-22.59	1.0350	-5.09	65	-5.96	1.0164	-11.92	126	16.31	0.9820	3.57	187	22.78	0.9666	-4.42
7	7	-22.47	1.0350	-5.52	66	-5.57	1.0158	-11.70	127	16.59	0.9816	3.65	188	22.69	0.9666	-4.60
8	8	-22.35	1.0350	-5.93	67	-5.19	1.0153	-11.47	128	16.87	0.9811	3.72	189	22.58	0.9666	-4.77
9	9	-22.21	1.0349	-6.34	68	-4.79	1.0147	-11.23	129	17.14	0.9806	3.78	190	22.47	0.9667	-4.93
10	10	-22.07	1.0348	-6.74	69	-4.40	1.0142	-10.98	130	17.41	0.9802	3.83	191	22.35	0.9667	-5.09
11	11	-21.93	1.0347	-7.14	70	-4.01	1.0136	-10.72	131	17.67	0.9797	3.87	192	22.23	0.9668	-5.24
12	12	-21.77	1.0347	-7.52	71	-3.62	1.0131	-10.46	132	17.93	0.9793	3.90	193	22.09	0.9668	-5.39
13	13	-21.61	1.0346	-7.90	72	-3.23	1.0125	-10.19	133	18.18	0.9788	3.92	194	21.96	0.9669	-5.53
14	14	-21.45	1.0344	-8.27	73	-2.83	1.0119	-9.92	134	18.43	0.9784	3.94	195	21.81	0.9670	-5.66
15	15	-21.27	1.0343	-8.63	74	-2.44	1.0114	-9.64	135	18.67	0.9779	3.94	196	21.66	0.9671	-5.79
16	16	-21.09	1.0342	-8.99	75	-2.04	1.0108	-9.36	136	18.91	0.9775	3.93	197	21.51	0.9672	-5.90
17	17	-20.90	1.0340	-9.33	76	-1.65	1.0102	-9.07	137	19.14	0.9771	3.91	198	21.35	0.9673	-6.01
18	18	-20.71	1.0339	-9.66	77	-1.25	1.0096	-8.77	138	19.37	0.9767	3.88	199	21.18	0.9674	-6.11
19	19	-20.51	1.0337	-9.99	78	-0.86	1.0091	-8.47	139	19.59	0.9763	3.85	200	21.00	0.9675	-6.20
20	20	-20.30	1.0335	-10.30	79	-0.46	1.0085	-8.17	140	19.81	0.9759	3.80	201	20.82	0.9677	-6.28
21	21	-20.09	1.0334	-10.60	80	-0.07	1.0079	-7.86	141	20.02	0.9755	3.74	202	20.64	0.9678	-6.35
22	22	-19.87	1.0332	-10.89	81	0.33	1.0073	-7.55	142	20.23	0.9751	3.68	203	20.44	0.9680	-6.42
23	23	-19.64	1.0330	-11.18	82	0.72	1.0067	-7.24	143	20.43	0.9747	3.61	204	20.25	0.9682	-6.47
24	24	-19.41	1.0327	-11.45	83	1.12	1.0061	-6.93	144	20.62	0.9744	3.52	205	20.04	0.9683	-6.52
25	25	-19.17	1.0325	-11.70	84	1.51	1.0056	-6.61	145	20.81	0.9740	3.43	206	19.84	0.9685	-6.55
26	26	-18.92	1.0323	-11.95	85	1.90	1.0050	-6.29	146	20.99	0.9737	3.33	207	19.62	0.9687	-6.58
27	27	-18.67	1.0320	-12.19	86	2.30	1.0044	-5.97	147	21.16	0.9733	3.23	208	19.40	0.9689	-6.59
28	28	-18.42	1.0318	-12.41	87	2.69	1.0038	-5.66	148	21.33	0.9730	3.11	209	19.18	0.9691	-6.60
29	29	-18.15	1.0315	-12.62	88	3.08	1.0032	-5.34	149	21.50	0.9727	2.99	210	18.95	0.9693	-6.59
30	30	-17.89	1.0312	-12.82	89	3.47	1.0026	-5.02	150	21.65	0.9723	2.86	211	18.71	0.9696	-6.57
31	31	-17.61	1.0309	-13.00	90	3.86	1.0020	-4.70	151	21.80	0.9720	2.72	212	18.47	0.9698	-6.55
1	32	-17.34	1.0306	-13.18	91	4.24	1.0014	-4.38	152	21.95	0.9717	2.58	213	18.22	0.9700	-6.51
2	33	-17.05	1.0303	-13.34	92	4.63	1.0008	-4.06	153	22.09	0.9714	2.42	214	17.97	0.9703	-6.46
3	34	-16.76	1.0300	-13.49	93	5.01	1.0002	-3.75	154	22.22	0.9711	2.27	215	17.72	0.9705	-6.41
4	35	-16.47	1.0297	-13.62	94	5.40	0.9996	-3.44	155	22.34	0.9709	2.10	216	17.46	0.9708	-6.34
5	36	-16.17	1.0294	-13.75	95	5.78	0.9990	-3.13	156	22.46	0.9706	1.93	217	17.19	0.9711	-6.26
6	37	-15.87	1.0290	-13.86	96	6.16	0.9985	-2.82	157	22.58	0.9703	1.76	218	16.92	0.9714	-6.17
7	38	-15.56	1.0287	-13.95	97	6.53	0.9979	-2.51	158	22.68	0.9701	1.58	219	16.65	0.9717	-6.07
8	39	-15.25	1.0283	-14.04	98	6.91	0.9973	-2.21	159	22.78	0.9698	1.39	220	16.37	0.9720	-5.96
9	40	-14.93	1.0279	-14.11	99	7.28	0.9967	-1.92	160	22.87	0.9696	1.20	221	16.09	0.9723	-5.83
10	41	-14.61	1.0276	-14.16	100	7.66	0.9961	-1.62	161	22.96	0.9694	1.01	222	15.80	0.9726	-5.70
11	42	-14.29	1.0272	-14.21	101	8.03	0.9955	-1.34	162	23.04	0.9691	0.81	223	15.51	0.9729	-5.56
12	43	-13.96	1.0268	-14.24	102	8.39	0.9950	-1.05	163	23.11	0.9689	0.60	224	15.21	0.9733	-5.40
13	44	-13.63	1.0264	-14.26	103	8.76	0.9944	-0.78	164	23.18	0.9687	0.40	225	14.91	0.9736	-5.24
14	45	-13.29	1.0260	-14.27	104	9.12	0.9938	-0.50	165	23.23	0.9685	0.19	226	14.61	0.9739	-5.07
15	46	-12.95	1.0256	-14.26	105	9.48	0.9932	-0.24	166	23.29	0.9684	-0.02	227	14.30	0.9743	-4.88
16	47	-12.61	1.0251	-14.24	106	9.84	0.9927	0.02	167	23.33	0.9682	-0.24	228	13.99	0.9747	-4.69
17	48	-12.26	1.0247	-14.21	107	10.19	0.9921	0.28	168	23.37	0.9680	-0.45	229	13.67	0.9750	-4.48
18	49	-11.91	1.0243	-14.17	108	10.55	0.9915	0.52	169	23.40	0.9679	-0.67	230	13.36	0.9754	-4.27
19	50	-11.56	1.0238	-14.11	109	10.89	0.9910	0.76	170	23.42	0.9677	-0.89	231	13.03	0.9758	-4.05
20	51	-11.20	1.0234	-14.04	110	11.24	0.9904	1.00	171	23.44	0.9676	-1.11	232	12.71	0.9762	-3.82
21	52	-10.84	1.0229	-13.96	111	11.58	0.9898	1.22	172	23.45	0.9674	-1.32	233	12.38	0.9766	-3.57
22	53	-10.48	1.0224	-13.87	112	11.92	0.9893	1.44	173	23.46	0.9673	-1.54	234	12.05	0.9770	-3.32
23	54	-10.12	1.0220	-13.76	113	12.26	0.9888	1.65	174	23.45	0.9672	-1.76	235	11.71	0.9774	-3.06
24	55	-9.75	1.0215	-13.65	114	12.60	0.9882	1.85	175	23.44	0.9671	-1.98	236	11.38	0.9778	-2.80
25	56	-9.38	1.0210	-13.52	115	12.93	0.9877	2.04	176	23.42	0.9670	-2.20	237	11.03	0.9783	-2.52
26	57	-9.01	1.0205	-13.39	116	13.25	0.9871	2.23	177	23.40	0.9669	-2.42	238	10.69	0.9787	-2.24
27	58	-8.63	1.0200	-13.24	117	13.57	0.9866	2.40	178	23.37	0.9669	-2.63	239	10.34	0.9791	-1.95
28	59	-8.26	1.0195	-13.08	118	13.89	0.9861	2.57	179	23.33	0.9668	-2.84	240	9.99	0.9796	-1.65
29					119	14.21	0.9856	2.73	180	23.29	0.9667	-3.05	241	9.64	0.9800	-1.34
30					120	14.52	0.9850	2.88	181	23.24	0.9667	-3.26	242	9.29	0.9805	-1.03
31													243	8.93	0.9810	-0.71

Nota. El valor de J expresado en la tabla corresponde al número de orden del día dentro de un año ordinario.
 Si el año es bisiesto el día $J = 60$ corresponderá al 29 de febrero en lugar de al 1 de marzo, y a partir de dicha fecha deberá sumarse una unidad al valor de J : por ejemplo, el día 31 de agosto de un año bisiesto tiene $J = 244$, el día 5 de diciembre de un año bisiesto tiene $J = 340$.

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 (M. Iqbal, *An Introduction to Solar Radiation*, Academic Press (1983))



DÍA MES	SEPTIEMBRE / OCTUBRE				NOVIEMBRE / DICIEMBRE			
	J	δ (°)	d_r	E_t (min)	J	δ (°)	d_r	E_t (min)
1	244	8.57	0.9814	-0.38	305	-14.19	1.0156	16.39
2	245	8.21	0.9819	-0.05	306	-14.51	1.0161	16.39
3	246	7.85	0.9824	0.29	307	-14.83	1.0167	16.37
4	247	7.48	0.9829	0.63	308	-15.14	1.0172	16.35
5	248	7.11	0.9834	0.98	309	-15.46	1.0177	16.31
6	249	6.74	0.9839	1.33	310	-15.76	1.0182	16.25
7	250	6.37	0.9844	1.69	311	-16.06	1.0188	16.18
8	251	6.00	0.9849	2.05	312	-16.36	1.0193	16.10
9	252	5.62	0.9854	2.41	313	-16.65	1.0198	16.01
10	253	5.25	0.9859	2.78	314	-16.94	1.0203	15.90
11	254	4.87	0.9865	3.15	315	-17.22	1.0208	15.77
12	255	4.49	0.9870	3.52	316	-17.50	1.0213	15.64
13	256	4.11	0.9875	3.89	317	-17.77	1.0217	15.49
14	257	3.73	0.9881	4.27	318	-18.04	1.0222	15.33
15	258	3.34	0.9886	4.64	319	-18.30	1.0227	15.15
16	259	2.96	0.9891	5.02	320	-18.56	1.0232	14.96
17	260	2.57	0.9897	5.40	321	-18.81	1.0236	14.76
18	261	2.19	0.9902	5.77	322	-19.06	1.0241	14.55
19	262	1.80	0.9908	6.15	323	-19.30	1.0245	14.32
20	263	1.41	0.9914	6.52	324	-19.53	1.0249	14.08
21	264	1.03	0.9919	6.90	325	-19.76	1.0254	13.83
22	265	0.64	0.9925	7.27	326	-19.98	1.0258	13.57
23	266	0.25	0.9930	7.64	327	-20.20	1.0262	13.30
24	267	-0.14	0.9936	8.01	328	-20.41	1.0266	13.01
25	268	-0.53	0.9942	8.37	329	-20.61	1.0270	12.71
26	269	-0.92	0.9948	8.73	330	-20.81	1.0274	12.41
27	270	-1.31	0.9953	9.09	331	-21.00	1.0278	12.09
28	271	-1.70	0.9959	9.44	332	-21.18	1.0281	11.76
29	272	-2.09	0.9965	9.79	333	-21.36	1.0285	11.42
30	273	-2.48	0.9971	10.13	334	-21.53	1.0289	11.07
1	274	-2.87	0.9977	10.47	335	-21.69	1.0292	10.72
2	275	-3.25	0.9983	10.80	336	-21.85	1.0295	10.35
3	276	-3.64	0.9988	11.13	337	-22.00	1.0299	9.98
4	277	-4.03	0.9994	11.44	338	-22.14	1.0302	9.59
5	278	-4.42	1.0000	11.76	339	-22.27	1.0305	9.20
6	279	-4.80	1.0006	12.06	340	-22.40	1.0308	8.80
7	280	-5.19	1.0012	12.36	341	-22.52	1.0311	8.40
8	281	-5.57	1.0018	12.65	342	-22.64	1.0314	7.98
9	282	-5.95	1.0024	12.93	343	-22.74	1.0316	7.56
10	283	-6.33	1.0030	13.20	344	-22.84	1.0319	7.14
11	284	-6.71	1.0036	13.46	345	-22.93	1.0322	6.71
12	285	-7.09	1.0042	13.71	346	-23.01	1.0324	6.27
13	286	-7.47	1.0047	13.95	347	-23.09	1.0326	5.83
14	287	-7.84	1.0053	14.19	348	-23.16	1.0329	5.38
15	288	-8.22	1.0059	14.41	349	-23.22	1.0331	4.93
16	289	-8.59	1.0065	14.62	350	-23.27	1.0333	4.48
17	290	-8.96	1.0071	14.82	351	-23.32	1.0335	4.02
18	291	-9.33	1.0077	15.01	352	-23.35	1.0336	3.56
19	292	-9.69	1.0083	15.19	353	-23.38	1.0338	3.10
20	293	-10.06	1.0088	15.36	354	-23.41	1.0340	2.64
21	294	-10.42	1.0094	15.51	355	-23.42	1.0341	2.17
22	295	-10.77	1.0100	15.66	356	-23.43	1.0343	1.71
23	296	-11.13	1.0106	15.79	357	-23.42	1.0344	1.24
24	297	-11.48	1.0111	15.91	358	-23.41	1.0345	0.78
25	298	-11.83	1.0117	16.01	359	-23.40	1.0346	0.31
26	299	-12.18	1.0123	16.11	360	-23.37	1.0347	-0.16
27	300	-12.52	1.0128	16.19	361	-23.34	1.0348	-0.62
28	301	-12.86	1.0134	16.25	362	-23.30	1.0349	-1.08
29	302	-13.20	1.0140	16.31	363	-23.25	1.0349	-1.54
30	303	-13.53	1.0145	16.35	364	-23.19	1.0350	-2.00
31	304	-13.86	1.0151	16.37	365	-23.13	1.0350	-2.45
					366	-23.06	1.0351	-2.90

Nota. El valor de J expresado en la tabla corresponde al número de orden del día dentro de un año ordinario. Si el año es bisiesto el día $J = 60$ corresponderá al 29 de febrero en lugar de al 1 de marzo, y a partir de dicha fecha deberá sumarse una unidad al valor de J : por ejemplo, el día 31 de agosto de un año bisiesto tiene $J = 244$, el día 5 de diciembre de un año bisiesto tiene $J = 340$.