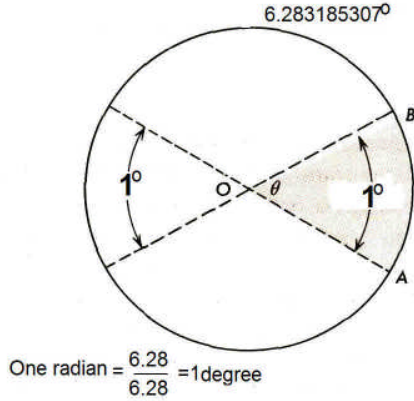
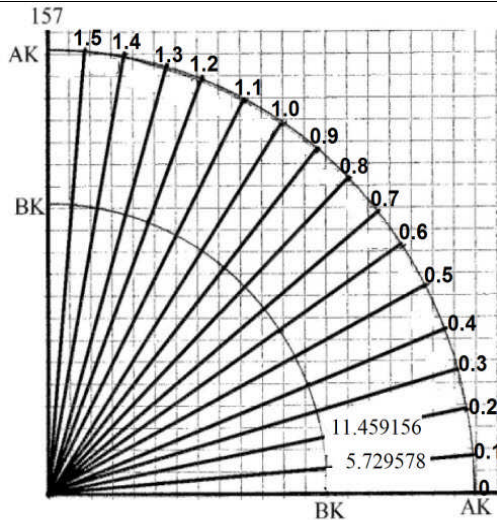
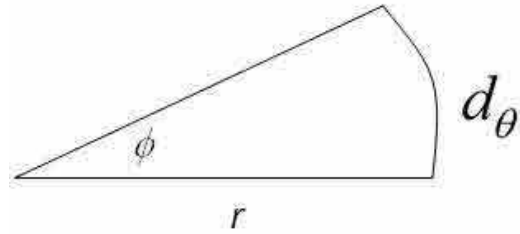


1 SECTION-8: Symmetry Math (SM) 6.28° or Radian Circle
2

The SM circle is based on 6.283185307 degrees or radians



$d_\phi = r\phi$ (ϕ is in radians or degrees)



	SM	sin	cos	tan
	0.000000	0.0000	1.0000	0.0000
	0.010000	0.0100	1.0000	0.0100
	0.100000	0.0998	0.9950	0.1003
	0.200000	0.1986	0.9800	0.2027
	0.300000	0.2955	0.9553	0.3093
	0.400000	0.3894	0.9211	0.4228
	0.500000	0.4794	0.8776	0.5463
	0.600000	0.5646	0.8253	0.6841
	0.700000	0.6442	0.7648	0.8423
	0.800000	0.7174	0.6967	1.0296
	0.900000	0.7833	0.6216	1.2602
	1.000000	0.8415	0.5403	1.5574
	1.100000	0.8912	0.4536	1.9648
	1.200000	0.9320	0.3624	2.5722
	1.300000	0.9636	0.2675	3.6021
	1.400000	0.9854	0.1700	5.7979
	1.500000	0.9975	0.0707	14.1014
	1.570796	1.0000	0.0000	1/0 is undefined

In SM, the sin of 1.57° is equal to 1.

3.141592654	π
6.283185307	2π
0.01745329252	1/57.29577951
$x = r \cos\phi$	$\cos\phi = x/r$
$y = r \sin\phi$	$\sin\phi = y/r$
$y = x \tan\phi$	$\tan\phi = y/x$

- 3
- 4
- 5
- 6
- 7

8 Rotational Motion

9

10 $\left[\phi(\text{radians}) = \frac{d_\phi}{r} = \frac{\text{arc length}}{\text{radius}} \right]$ One radian is an angle whose arc distance is equal to its radius.

11

12 $C = 2\pi r$ Circumference of a circle is equal to $[2\pi = 2(3.14)] = 6.28$ times its radius.

13

14 $1(\text{radian}) = \frac{(1)2\pi}{2\pi} = \frac{6.28318^0}{2\pi} = \frac{6.28318^0}{6.28318} = 1^0$ SM definition

15

16 $\left[1(\text{radian}) = \frac{360^0}{2\pi} \approx \frac{360^0}{6.28} \approx 57.3^0 \right]$ Broken-Symmetry (BS) Math definition

17

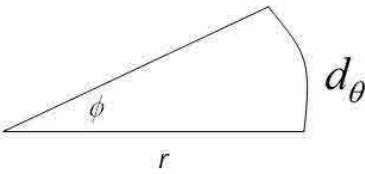
radius	SM-deg	arc length	BSM-deg	SM sin ϕ	BSM sin ϕ
1	1	1	57.32	0.8417	0.8417
1	0.01	0.01	0.57	0.0100	0.0100
1	0.1	0.1	5.73	0.0998	0.0998
1	0.2	0.2	11.46	0.1987	0.1987
1	0.3	0.3	17.20	0.2956	0.2956
1	0.4	0.4	22.93	0.3896	0.3896
1	0.5	0.5	28.66	0.4796	0.4796
1	0.6	0.6	34.39	0.5649	0.5649
1	0.7	0.7	40.12	0.6445	0.6445
1	0.8	0.8	45.86	0.7176	0.7176
1	0.9	0.9	51.59	0.7836	0.7836
1	1	1	57.32	0.8417	0.8417
1	1.1	1.1	63.05	0.8914	0.8914
1	1.2	1.2	68.78	0.9322	0.9322
1	1.3	1.3	74.52	0.9637	0.9637
1	1.4	1.4	80.25	0.9855	0.9855
1	1.5	1.5	85.98	0.9975	0.9975
1	1.57	1.57	89.99	1.0000	1.0000

35 In SM, the sin of 1.57 degrees is equal to 1. In BS math, the sin of 90 degrees is equal to 1.

36

radius	SM-deg	arc length	SM sin ϕ
1	1	1	0.8417
1	0.01	0.01	0.0100
1	0.1	0.1	0.0998
1	0.2	0.2	0.1987
1	0.3	0.3	0.2956
1	0.4	0.4	0.3896
1	0.5	0.5	0.4796
1	0.6	0.6	0.5649
1	0.7	0.7	0.6445
1	0.8	0.8	0.7176
1	0.9	0.9	0.7836
1	1	1	0.8417
1	1.1	1.1	0.8914
1	1.2	1.2	0.9322
1	1.3	1.3	0.9637
1	1.4	1.4	0.9855
1	1.5	1.5	0.9975
1	1.57	1.57	1.0000

51

$d_\phi = r\phi(\text{radians})$ $d_\phi = r\phi(\text{degrees})$	$d_\phi =$ the arc distance around the circumference of a circle $r =$ radius 	$d_\phi = r\phi$ $\vec{v}_{d\phi} = \frac{\Delta d_\phi}{\Delta t} = r \frac{\Delta \phi}{\Delta t}$ $\vec{a}_{d\phi} = \frac{\Delta \vec{v}_{d\phi}}{\Delta t} = \frac{\Delta^2 d_\phi}{\Delta t^2} = r \frac{\Delta^2 \phi}{\Delta t^2}$
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52 $\phi =$ angle in radians (0 to 6.28 radians) ($1^\circ = 1$ radian) and $\phi =$ angle in degrees

$\vec{v}_{\phi(av)} = \frac{\Delta \phi}{\Delta t}$	The <u>average angular velocity</u> of a body is the rate of its angular displacement.	
$\vec{v}_{\phi(inst)} = \lim_{\Delta t \rightarrow 0} \frac{\Delta \phi}{\Delta t}$	The <u>instantaneous angular velocity</u> is the limit of the ratio $\frac{\Delta \phi}{\Delta t}$ as Δt approaches zero	
$\vec{v}_{d\phi(av)} = \frac{\Delta d_\phi}{\Delta t}$	The <u>average circumference velocity</u> of the body is the rate of its distance traveled Δd_ϕ divided by the time Δt	
$\vec{v}_\phi = \frac{\vec{v}_{d\phi}}{r}$	$\vec{v}_\phi = \frac{\Delta \phi}{\Delta t} = \frac{\Delta d_\phi / r}{\Delta t} = \frac{\Delta d_\phi}{\Delta t} \frac{1}{r} = \frac{\vec{v}_{d\phi}}{r}$	The equation of the relationship between the angular velocity and the velocity of a point on that body
$\vec{a}_{\phi(av)} = \frac{\vec{v}_\phi - \vec{v}_{\phi o}}{\Delta t} = \frac{\Delta \vec{v}_\phi}{\Delta t}$	The <u>average angular acceleration</u> is the change in the angular velocity.	
$a_{\phi(inst)} = \lim_{\Delta t \rightarrow 0} \frac{\Delta v_\phi}{\Delta t}$	The instantaneous angular acceleration is the limit of the ration of $\frac{\Delta \vec{v}_\phi}{\Delta t}$ as Δt approaches zero	
$\vec{a}_\phi = \frac{\vec{a}_{d\phi}}{r}$	$\vec{a}_\phi = \frac{\Delta \vec{v}_\phi}{\Delta t} = \frac{\Delta \vec{v}_{d\phi}}{r} \frac{1}{\Delta t}$ $= \frac{1}{r} \frac{\Delta \vec{v}_{d\phi}}{\Delta t} = \frac{\vec{a}_{d\phi}}{r}$	The equation of the relationship between the angular acceleration and the acceleration of a point on the body
$\phi = \vec{v}_\phi t + \frac{1}{2} \vec{a}_\phi t^2$	If a body with an initial angular velocity $\vec{v}_{\phi o}$ has a constant angular acceleration \vec{a}_ϕ , it will turn through an angle ϕ in a time "t"	

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56 *The 360-degree circle is 4400 years old and extremely outdated.

57 Q: Why does a circle have 360 degrees; why not 100 degrees? Also why is a degree
58 60 minutes and a minute 60 seconds? --**HSR, Pakistan**

59 **A:** A probable answer. A line of ancient peoples (Sumerians, Akkadians, and
60 Babylonians) who lived in Mesopotamia invented writing, observed the skies, and
61 invented a 360-degree circle to describe their findings. About 3000 BC, the
62 Sumerians invented writing. They also had a calendar, dating from 2400 BC, that
63 divided the year into 12 months of 30 days each, that is, 360 days.

64 The Sumerians watched the Sun, Moon, and the five visible planets (Mercury,
65 Venus, Mars, Jupiter, and Saturn), primarily for omens. They did not try to
66 understand the motions physically. They did, however, notice the circular track of
67 the Sun's annual path across the sky and knew that it took about 360 days to
68 complete one year's circuit. Consequently, they divided the circular path into 360
69 degrees to track each day's passage of the Sun's whole journey. This probably
70 happened about 2400 BC.

71 A 100-degree circle makes sense for base 10 people like us. But the base-60
72 Babylonians came up with 360° and we cling to their ways; 4400 years later.

73 **SM** will be using a circle with 6.283185307° .

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BSM	SM	sin	cos	tan
0.000000	0.000000	0.0000	1.0000	0.0000
0.5729577951	0.010000	0.0100	1.0000	0.0100
1.14592	0.020000	0.0200	0.9998	0.0200
1.71887	0.030000	0.0300	0.9996	0.0300
2.29183	0.040000	0.0400	0.9992	0.0400
2.86479	0.050000	0.0500	0.9988	0.0500
3.43775	0.060000	0.0600	0.9982	0.0601
4.01070	0.070000	0.0699	0.9976	0.0701
4.58366	0.080000	0.0799	0.9968	0.0802
5.15662	0.090000	0.0899	0.9960	0.0902
5.72958	0.100000	0.0998	0.9950	0.1003
6.30254	0.110000	0.1098	0.9940	0.1104
6.87549	0.120000	0.1197	0.9928	0.1206
7.44845	0.130000	0.1296	0.9916	0.1307
8.02141	0.140000	0.1395	0.9902	0.1409
8.59437	0.150000	0.1494	0.9888	0.1511
9.16732	0.160000	0.1593	0.9872	0.1614
9.74028	0.170000	0.1692	0.9856	0.1717
10.31324	0.180000	0.1790	0.9838	0.1820
10.88620	0.190000	0.1889	0.9820	0.1923
11.45916	0.200000	0.1987	0.9801	0.2027
12.03211	0.210000	0.2085	0.9780	0.2131
12.60507	0.220000	0.2182	0.9759	0.2236
13.17803	0.230000	0.2280	0.9737	0.2341
13.75099	0.240000	0.2377	0.9713	0.2447
14.32394	0.250000	0.2474	0.9689	0.2553
14.89690	0.260000	0.2571	0.9664	0.2660
15.46986	0.270000	0.2667	0.9638	0.2768
16.04282	0.280000	0.2764	0.9611	0.2876
16.61578	0.290000	0.2860	0.9582	0.2984
17.18873	0.300000	0.2955	0.9553	0.3093
17.76169	0.310000	0.3051	0.9523	0.3203
18.33465	0.320000	0.3146	0.9492	0.3314
18.90761	0.330000	0.3240	0.9460	0.3425
19.48057	0.340000	0.3335	0.9428	0.3537
20.05352	0.350000	0.3429	0.9394	0.3650
20.62648	0.360000	0.3523	0.9359	0.3764
21.19944	0.370000	0.3616	0.9323	0.3879
21.77240	0.380000	0.3709	0.9287	0.3994
22.34535	0.390000	0.3802	0.9249	0.4111
22.91831	0.400000	0.3894	0.9211	0.4228
23.49127	0.410000	0.3986	0.9171	0.4346
24.06423	0.420000	0.4078	0.9131	0.4466
24.63719	0.430000	0.4169	0.9090	0.4586
25.21014	0.440000	0.4259	0.9048	0.4708
25.78310	0.450000	0.4350	0.9004	0.4831
26.35606	0.460000	0.4439	0.8961	0.4954

BSM	SM	Sin	Cos	Tan
26.92902	0.470000	0.4529	0.8916	0.5080
27.50197	0.480000	0.4618	0.8870	0.5206
28.07493	0.490000	0.4706	0.8823	0.5334
28.64789	0.500000	0.4794	0.8776	0.5463
29.22085	0.510000	0.4882	0.8727	0.5594
29.79381	0.520000	0.4969	0.8678	0.5726
30.00000	0.523599	0.5000	0.8660	0.5774
30.36676	0.530000	0.5055	0.8628	0.5859
30.93972	0.540000	0.5141	0.8577	0.5994
31.51268	0.550000	0.5227	0.8525	0.6131
32.08564	0.560000	0.5312	0.8473	0.6269
32.65859	0.570000	0.5396	0.8419	0.6410
33.23155	0.580000	0.5480	0.8365	0.6552
33.80451	0.590000	0.5564	0.8309	0.6696
34.37747	0.600000	0.5646	0.8253	0.6841
34.95043	0.610000	0.5729	0.8196	0.6989
36.09634	0.630000	0.5891	0.8080	0.7291
36.66930	0.640000	0.5972	0.8021	0.7445
37.24226	0.650000	0.6052	0.7961	0.7602
37.81521	0.660000	0.6131	0.7900	0.7761
38.38817	0.670000	0.6210	0.7838	0.7923
38.96113	0.680000	0.6288	0.7776	0.8087
39.53409	0.690000	0.6365	0.7712	0.8253
40.10705	0.700000	0.6442	0.7648	0.8423
40.68000	0.710000	0.6518	0.7584	0.8595
41.25296	0.720000	0.6594	0.7518	0.8771
41.82592	0.730000	0.6669	0.7452	0.8949
42.39888	0.740000	0.6743	0.7385	0.9131
42.97183	0.750000	0.6816	0.7317	0.9316
43.54479	0.760000	0.6889	0.7248	0.9505
44.11775	0.770000	0.6961	0.7179	0.9697
44.69071	0.780000	0.7033	0.7109	0.9893
45.00000	0.785398	0.7071	0.7071	1.0000
45.26367	0.790000	0.7104	0.7038	1.0092
45.83662	0.800000	0.7174	0.6967	1.0296
46.40958	0.810000	0.7243	0.6895	1.0505
46.98254	0.820000	0.7311	0.6822	1.0717
47.55550	0.830000	0.7379	0.6749	1.0934
48.12845	0.840000	0.7446	0.6675	1.1156
48.70141	0.850000	0.7513	0.6600	1.1383
49.27437	0.860000	0.7578	0.6524	1.1616
49.84733	0.870000	0.7643	0.6448	1.1853
50.42029	0.880000	0.7707	0.6372	1.2097
50.99324	0.890000	0.7771	0.6294	1.2346
51.56620	0.900000	0.7833	0.6216	1.2602
52.13916	0.910000	0.7895	0.6137	1.2864
52.71212	0.920000	0.7956	0.6058	1.3133

BSM	SM	Sin	Cos	Tan
53.28507	0.930000	0.8016	0.5978	1.3409
53.85803	0.940000	0.8076	0.5898	1.3692
54.43099	0.950000	0.8134	0.5817	1.3984
55.00395	0.960000	0.8192	0.5735	1.4284
55.57691	0.970000	0.8249	0.5653	1.4592
56.14986	0.980000	0.8305	0.5570	1.4910
56.72282	0.990000	0.8360	0.5487	1.5237
57.29578	1.000000	0.8415	0.5403	1.5574
57.86874	1.010000	0.8468	0.5319	1.5922
58.44170	1.020000	0.8521	0.5234	1.6281
59.01465	1.030000	0.8573	0.5148	1.6652
59.58761	1.040000	0.8624	0.5062	1.7036
60.00000	1.047198	0.8660	0.5000	1.7321
60.16057	1.050000	0.8674	0.4976	1.7433
60.73353	1.060000	0.8724	0.4889	1.7844
61.30648	1.070000	0.8772	0.4801	1.8270
61.87944	1.080000	0.8820	0.4713	1.8712
62.45240	1.090000	0.8866	0.4625	1.9171
63.02536	1.100000	0.8912	0.4536	1.9648
63.59832	1.110000	0.8957	0.4447	2.0143
64.17127	1.120000	0.9001	0.4357	2.0660
64.74423	1.130000	0.9044	0.4267	2.1198
65.31719	1.140000	0.9086	0.4176	2.1759
65.89015	1.150000	0.9128	0.4085	2.2345
66.46310	1.160000	0.9168	0.3993	2.2958
67.03606	1.170000	0.9208	0.3902	2.3600
67.60902	1.180000	0.9246	0.3809	2.4273
68.18198	1.190000	0.9284	0.3717	2.4979
68.75494	1.200000	0.9320	0.3624	2.5722
69.32789	1.210000	0.9356	0.3530	2.6503
69.90085	1.220000	0.9391	0.3436	2.7328
70.47381	1.230000	0.9425	0.3342	2.8198
71.04677	1.240000	0.9458	0.3248	2.9119
71.61972	1.250000	0.9490	0.3153	3.0096
72.19268	1.260000	0.9521	0.3058	3.1133
72.76564	1.270000	0.9551	0.2963	3.2236
73.33860	1.280000	0.9580	0.2867	3.3413
73.91156	1.290000	0.9608	0.2771	3.4672
74.48451	1.300000	0.9636	0.2675	3.6021
75.05747	1.310000	0.9662	0.2579	3.7471
75.63043	1.320000	0.9687	0.2482	3.9033
76.20339	1.330000	0.9711	0.2385	4.0711
76.77634	1.340000	0.9735	0.2288	4.2556
77.34930	1.350000	0.9757	0.2190	4.4552
77.92226	1.360000	0.9779	0.2092	4.6734
78.49522	1.370000	0.9799	0.1994	4.9131
79.06818	1.380000	0.9819	0.1896	5.1774
79.64113	1.390000	0.9837	0.1798	5.4707

BSM	SM	Sin	Cos	Tan
80.21409	1.400000	0.9854	0.1700	5.7979
80.78705	1.410000	0.9871	0.1601	6.1654
81.36001	1.420000	0.9887	0.1502	6.5811
81.93296	1.430000	0.9901	0.1403	7.0555
82.50592	1.440000	0.9915	0.1304	7.6018
83.07888	1.450000	0.9927	0.1205	8.2381
83.65184	1.460000	0.9939	0.1106	8.9886
84.22480	1.470000	0.9949	0.1006	9.8874
84.79775	1.480000	0.9959	0.0907	10.9834
85.37071	1.490000	0.9967	0.0807	12.3499
85.94367	1.500000	0.9975	0.0707	14.1014
86.51663	1.510000	0.9982	0.0608	16.4281
87.08958	1.520000	0.9987	0.0508	19.6695
87.66254	1.530000	0.9992	0.0408	24.4984
88.23550	1.540000	0.9995	0.0308	32.4611
88.80846	1.550000	0.9998	0.0208	48.0785
89.38142	1.560000	0.9999	0.0108	92.6205
89.95437	1.570000	1.0000	0.0008	1255.7658
90.00000	1.570796	1.0000	0.0000	1/0 is undefined