

MASTER CALCULATIONS SHEET

REFER TO DIAGRAM SHOWING WHEEL WITH MOVING MAGNETS P+ AND P-; AND FOUR STATIONARY MAGNETS A, B, C, AND D ON THE AXIS ALONG WHICH WHEEL MOVES
THIS SHEET SHOWS THE DISTANCE FOR P+ AND P- FROM THE FIXED MAGNETS A, B, C AND D

$\pi = 3.14159265$

P O I N T	CENTRE OF WHEEL ALONG X	X VALUES FOR THE P+ AND P- ON WHEEL		Y VALUES FOR THE P+ AND P- ON WHEEL		DIST OF P+ TO STATIONERY POINTS A,B,C,D				DIST OF P- TO STATIONERY POINTS A,B,C,D			
		variable Xc	variable Xp+	variable Xp-	variable Yp+	variable Yp-	dist P+ to A+	dist P+ to B-	dist P+ to C+	dist P+ to D-	dist P- to A+	dist P- to B-	dist P- to C+
0	0	0.0000	0.0000	2.0000	-2.0000	3.6056	3.6056	21.0950	27.0740	3.6056	3.6056	21.0950	27.0740
1	0.2	0.3047	0.0953	1.9973	-1.9973	3.8613	3.3547	20.7915	26.7699	3.6838	3.5251	20.9999	26.9787
2	0.4	0.6091	0.1909	1.9890	-1.9890	4.1209	3.1101	20.4877	26.4658	3.7601	3.4420	20.9039	26.8827
3	0.6	0.9129	0.2871	1.9754	-1.9754	4.3832	2.8737	20.1840	26.1618	3.8350	3.3559	20.8069	26.7858
4	0.8	1.2158	0.3842	1.9563	-1.9563	4.6476	2.6477	19.8807	25.8583	3.9089	3.2664	20.7084	26.6876
5	1	1.5176	0.4824	1.9319	-1.9319	4.9134	2.4350	19.5779	25.5555	3.9823	3.1734	20.6084	26.5879
6	1.2	1.8180	0.5820	1.9021	-1.9021	5.1799	2.2394	19.2760	25.2537	4.0557	3.0765	20.5064	26.4864
7	1.4	2.1167	0.6833	1.8672	-1.8672	5.4468	2.0655	18.9754	24.9532	4.1295	2.9755	20.4024	26.3829
8	1.6	2.4135	0.7865	1.8271	-1.8271	5.7135	1.9189	18.6761	24.6543	4.2043	2.8701	20.2959	26.2771
9	1.8	2.7080	0.8920	1.7820	-1.7820	5.9797	1.8058	18.3786	24.3573	4.2806	2.7603	20.1868	26.1687
10	2	3.0000	1.0000	1.7321	-1.7321	6.2450	1.7321	18.0831	24.0624	4.3589	2.6458	20.0749	26.0576
11	2.2	3.2893	1.1107	1.6773	-1.6773	6.5091	1.7021	17.7900	23.7700	4.4398	2.5264	19.9599	25.9436
12	2.4	3.5756	1.2244	1.6180	-1.6180	6.7717	1.7174	17.4994	23.4802	4.5237	2.4022	19.8417	25.8263
13	2.6	3.8586	1.3414	1.5543	-1.5543	7.0326	1.7757	17.2117	23.1935	4.6112	2.2731	19.7200	25.7057
14	2.8	4.1383	1.4617	1.4863	-1.4863	7.2914	1.8721	16.9271	22.9100	4.7028	2.1390	19.5947	25.5815
15	3	4.4142	1.5858	1.4142	-1.4142	7.5479	2.0000	16.6460	22.6300	4.7989	2.0000	19.4657	25.4535
16	3.2	4.6863	1.7137	1.3383	-1.3383	7.8019	2.1528	16.3685	22.3538	4.9000	1.8562	19.3327	25.3217
17	3.4	4.9543	1.8457	1.2586	-1.2586	8.0533	2.3245	16.0950	22.0816	5.0065	1.7078	19.1956	25.1858
18	3.6	5.2180	1.9820	1.1756	-1.1756	8.3017	2.5103	15.8257	21.8137	5.1188	1.5551	19.0543	25.0456
19	3.8	5.4773	2.1227	1.0893	-1.0893	8.5470	2.7062	15.5608	21.5502	5.2372	1.3987	18.9087	24.9012
20	4	5.7321	2.2679	1.0000	-1.0000	8.7891	2.9093	15.3007	21.2914	5.3620	1.2393	18.7587	24.7523
21	4.2	5.9820	2.4180	0.9080	-0.9080	9.0278	3.1172	15.0454	21.0376	5.4935	1.0785	18.6042	24.5988
22	4.4	6.2271	2.5729	0.8135	-0.8135	9.2629	3.3280	14.7953	20.7888	5.6320	0.9188	18.4450	24.4406
23	4.6	6.4672	2.7328	0.7167	-0.7167	9.4943	3.5405	14.5505	20.5453	5.7775	0.7649	18.2812	24.2777
24	4.8	6.7021	2.8979	0.6180	-0.6180	9.7218	3.7533	14.3112	20.3073	5.9302	0.6264	18.1127	24.1100
25	5	6.9319	3.0681	0.5176	-0.5176	9.9453	3.9658	14.0777	20.0748	6.0902	0.5221	17.9393	23.9374
26	5.2	7.1563	3.2437	0.4158	-0.4158	10.1648	4.1770	13.8499	19.8481	6.2575	0.4820	17.7612	23.7599
27	5.4	7.3754	3.4246	0.3129	-0.3129	10.3801	4.3865	13.6282	19.6271	6.4322	0.5274	17.5782	23.5775
28	5.6	7.5890	3.6110	0.2091	-0.2091	10.5911	4.5938	13.4126	19.4121	6.6143	0.6457	17.3903	23.3900
29	5.8	7.7973	3.8027	0.1047	-0.1047	10.7978	4.7984	13.2032	19.2030	6.8035	0.8095	17.1976	23.1975
30	6	8.0000	4.0000	0.0000	0.0000	11.0000	5.0000	13.0000	19.0000	7.0000	1.0000	17.0000	23.0000
31	6.2	8.1973	4.2027	-0.1047	0.1047	11.1977	5.1983	12.8032	18.8030	7.2035	1.2073	16.7976	22.7975
32	6.4	8.3890	4.4110	-0.2091	0.2091	11.3910	5.3931	12.6127	18.6121	7.4139	1.4264	16.5904	22.5900
33	6.6	8.5754	4.6246	-0.3129	0.3129	11.5796	5.5841	12.4286	18.4273	7.6310	1.6545	16.3784	22.3776
34	6.8	8.7563	4.8437	-0.4158	0.4158	11.7636	5.7713	12.2508	18.2484	7.8547	1.8900	16.1616	22.1602
35	7	8.9319	5.0681	-0.5176	0.5176	11.9431	5.9544	12.0792	18.0756	8.0847	2.1319	15.9403	21.9380
36	7.2	9.1021	5.2979	-0.6180	0.6180	12.1179	6.1333	11.9139	17.9086	8.3209	2.3795	15.7143	21.7109
37	7.4	9.2672	5.5328	-0.7167	0.7167	12.2881	6.3080	11.7547	17.7473	8.5629	2.6323	15.4838	21.4791
38	7.6	9.4271	5.7729	-0.8135	0.8135	12.4537	6.4784	11.6015	17.5917	8.8105	2.8898	15.2488	21.2427
39	7.8	9.5820	6.0180	-0.9080	0.9080	12.6147	6.6443	11.4540	17.4416	9.0636	3.1516	15.0095	21.0016

MASTER CALCULATIONS SHEET

THIS SHEET SHOWS THE TANGENTIAL FORCE (TF) ACTING ON P+ AND P- DUE TO THE INFLUENCE OF MAGNETS A, B, C AND D AS THE WHEEL MOVES ALONG THE AXIS

P O I N T	CENTRE OF WHEEL ALONG X	TANGENT FORCE P+ & P- DUE TO B-		TANGENT FORCE P+ & P- DUE TO A+		TANGENT FORCE P+ & P- DUE TO C+		TANGENT FORCE P+ & P- DUE TO D-		1/r^2	
		variable Xc	TF P+ to B-	TF P- to B-	TF P+ to A+	TF P- to A+	TF P+ to C+	TF P- to C+	TF P+ to D-		TF P- to D-
0	0		0.8321	0.8321	0.8321	0.8321	-0.9955	-0.9955	0.9973	0.9973	
1	0.2		0.8335	0.7932	0.8276	0.8675	-0.9990	-0.9891	0.9998	0.9920	
2	0.4		0.8314	0.7512	0.8205	0.8993	-1.0000	-0.9801	0.9996	0.9841	
3	0.6		0.8249	0.7064	0.8112	0.9272	-0.9983	-0.9684	0.9967	0.9735	
4	0.8		0.8127	0.6588	0.7998	0.9509	-0.9939	-0.9541	0.9911	0.9603	
5	1		0.7934	0.6088	0.7864	0.9702	-0.9868	-0.9374	0.9827	0.9446	
6	1.2		0.7644	0.5564	0.7711	0.9849	-0.9769	-0.9183	0.9716	0.9264	
7	1.4		0.7232	0.5020	0.7542	0.9947	-0.9643	-0.8969	0.9578	0.9059	
8	1.6		0.6665	0.4456	0.7355	0.9995	-0.9490	-0.8732	0.9412	0.8831	
9	1.8		0.5921	0.3874	0.7152	0.9991	-0.9308	-0.8475	0.9218	0.8580	
10	2		0.5000	0.3273	0.6934	0.9934	-0.9099	-0.8197	0.8998	0.8309	
11	2.2		0.3942	0.2656	0.6700	0.9823	-0.8863	-0.7899	0.8750	0.8017	
12	2.4		0.2826	0.2021	0.6451	0.9657	-0.8599	-0.7584	0.8476	0.7706	
13	2.6		0.1751	0.1368	0.6188	0.9438	-0.8308	-0.7251	0.8176	0.7377	
14	2.8		0.0794	0.0695	0.5911	0.9165	-0.7990	-0.6902	0.7850	0.7030	
15	3		-0.0000	0.0000	0.5621	0.8841	-0.7646	-0.6539	0.7499	0.6667	
16	3.2		-0.0622	-0.0721	0.5317	0.8467	-0.7276	-0.6161	0.7124	0.6289	
17	3.4		-0.1083	-0.1474	0.5001	0.8045	-0.6882	-0.5770	0.6726	0.5897	
18	3.6		-0.1405	-0.2268	0.4673	0.7579	-0.6463	-0.5368	0.6305	0.5492	
19	3.8		-0.1610	-0.3115	0.4333	0.7072	-0.6020	-0.4954	0.5863	0.5074	
20	4		-0.1719	-0.4034	0.3982	0.6527	-0.5555	-0.4531	0.5401	0.4646	
21	4.2		-0.1748	-0.5051	0.3621	0.5950	-0.5069	-0.4100	0.4920	0.4208	
22	4.4		-0.1711	-0.6198	0.3249	0.5344	-0.4563	-0.3661	0.4422	0.3761	
23	4.6		-0.1620	-0.7496	0.2869	0.4714	-0.4039	-0.3215	0.3907	0.3307	
24	4.8		-0.1482	-0.8880	0.2479	0.4065	-0.3498	-0.2764	0.3378	0.2845	
25	5		-0.1305	-0.9914	0.2082	0.3400	-0.2942	-0.2308	0.2836	0.2379	
26	5.2		-0.1095	-0.9490	0.1677	0.2725	-0.2372	-0.1850	0.2284	0.1908	
27	5.4		-0.0856	-0.7118	0.1266	0.2043	-0.1791	-0.1388	0.1722	0.1433	
28	5.6		-0.0592	-0.4209	0.0849	0.1359	-0.1200	-0.0926	0.1152	0.0956	
29	5.8		-0.0305	-0.1810	0.0427	0.0677	-0.0603	-0.0463	0.0578	0.0478	
30	6		-0.0000	0.0000	0.0000	-0.0000	-0.0000	0.0000	0.0000	-0.0000	
31	6.2		0.0322	0.1387	-0.0430	-0.0668	0.0605	0.0461	-0.0579	-0.0478	
32	6.4		0.0659	0.2492	-0.0863	-0.1325	0.1210	0.0920	-0.1157	-0.0953	
33	6.6		0.1009	0.3404	-0.1297	-0.1968	0.1812	0.1375	-0.1732	-0.1426	
34	6.8		0.1369	0.4180	-0.1732	-0.2594	0.2410	0.1827	-0.2301	-0.1895	
35	7		0.1739	0.4856	-0.2167	-0.3201	0.3000	0.2273	-0.2864	-0.2360	
36	7.2		0.2116	0.5454	-0.2601	-0.3788	0.3579	0.2714	-0.3417	-0.2818	
37	7.4		0.2500	0.5990	-0.3033	-0.4353	0.4146	0.3148	-0.3958	-0.3270	
38	7.6		0.2888	0.6475	-0.3462	-0.4893	0.4698	0.3574	-0.4485	-0.3715	
39	7.8		0.3280	0.6914	-0.3887	-0.5410	0.5232	0.3993	-0.4998	-0.4150	

RESULTANT FORCES ON P+ AND P-

RESULTANT FORCES MASTER SHEET WITH TOTAL RESULTANT FORCES ACTING ON P+ AND P- DUE TO MAGNETS A, B, C AND D AS WHEEL MOVES ALONG ITS AXIS
 REFER TO MASTER SHEET FOR CALCULATION OF DISTANCE FROM A, B, C AND D TO P+ AND P-

force = k/r^2

P O I N T	CENTRE OF WHEEL ALONG X variable Xc	FORCES ON P+ DUE TO MAGNETS A,B,C,D				SUM OF FORCES ON P+	FORCES ON P- DUE TO MAGNETS A,B,C,D				SUM OF FORCES ON P-	P O I N T	SUM OF FORCES ON P+ & P-	CENTRE OF WHEEL ALONG X variable Xc
		P+A+	P+B-	P+C+	P+D-	NET FORCE ON P+	P-A+	P-B-	P-C+	P-D-	NET FORCE ON P-		NET FORCE	
0	0	0.064004	0.064004	-0.002237	0.001361	0.127131	0.064004	0.064004	-0.002237	0.001361	0.127131	0	0.254262	0
1	0.2	0.055506	0.074065	-0.002311	0.001395	0.128655	0.063926	0.063835	-0.002243	0.001363	0.126881	1	0.255536	0.2
2	0.4	0.048320	0.085951	-0.002382	0.001427	0.133316	0.063605	0.063412	-0.002243	0.001362	0.126136	2	0.259452	0.4
3	0.6	0.042222	0.099885	-0.002450	0.001456	0.141113	0.063041	0.062722	-0.002237	0.001357	0.124883	3	0.265996	0.6
4	0.8	0.037025	0.115935	-0.002515	0.001482	0.151928	0.062232	0.061745	-0.002225	0.001348	0.123101	4	0.275029	0.8
5	1	0.032574	0.133799	-0.002574	0.001505	0.165303	0.061178	0.060450	-0.002207	0.001336	0.120757	5	0.286059	1
6	1.2	0.028740	0.152427	-0.002629	0.001524	0.180062	0.059878	0.058790	-0.002184	0.001321	0.117805	6	0.297866	1.2
7	1.4	0.025421	0.169501	-0.002678	0.001538	0.193782	0.058333	0.056702	-0.002155	0.001301	0.114181	7	0.307963	1.4
8	1.6	0.022531	0.181002	-0.002721	0.001548	0.202361	0.056547	0.054094	-0.002120	0.001279	0.109800	8	0.312161	1.6
9	1.8	0.020003	0.181579	-0.002756	0.001554	0.200380	0.054527	0.050840	-0.002080	0.001253	0.104540	9	0.304920	1.8
10	2	0.017779	0.166667	-0.002783	0.001554	0.183217	0.052284	0.046761	-0.002034	0.001224	0.098235	10	0.281452	2
11	2.2	0.015814	0.136058	-0.002800	0.001549	0.150620	0.049833	0.041606	-0.001983	0.001191	0.090647	11	0.241267	2.2
12	2.4	0.014069	0.095836	-0.002808	0.001537	0.108634	0.047192	0.035016	-0.001926	0.001155	0.081437	12	0.190071	2.4
13	2.6	0.012513	0.055521	-0.002804	0.001520	0.066749	0.044386	0.026468	-0.001865	0.001116	0.070105	13	0.136855	2.6
14	2.8	0.011119	0.022653	-0.002789	0.001496	0.032479	0.041442	0.015187	-0.001798	0.001074	0.055905	14	0.088385	2.8
15	3	0.009866	-0.000000	-0.002759	0.001464	0.008571	0.038389	0.000000	-0.001726	0.001029	0.037693	15	0.046264	3
16	3.2	0.008736	-0.013413	-0.002716	0.001426	-0.005968	0.035263	-0.020925	-0.001648	0.000981	0.013670	16	0.007702	3.2
17	3.4	0.007711	-0.020041	-0.002657	0.001379	-0.013607	0.032096	-0.050539	-0.001566	0.000930	-0.019079	17	-0.032686	3.4
18	3.6	0.006781	-0.022294	-0.002580	0.001325	-0.016769	0.028924	-0.093775	-0.001478	0.000875	-0.065454	18	-0.082223	3.6
19	3.8	0.005932	-0.021984	-0.002486	0.001263	-0.017276	0.025782	-0.159243	-0.001386	0.000818	-0.134028	19	-0.151304	3.8
20	4	0.005155	-0.020305	-0.002373	0.001191	-0.016331	0.022703	-0.262680	-0.001288	0.000758	-0.240506	20	-0.256837	4
21	4.2	0.004443	-0.017986	-0.002239	0.001112	-0.014671	0.019716	-0.434274	-0.001184	0.000695	-0.415047	21	-0.429718	4.2
22	4.4	0.003787	-0.015448	-0.002085	0.001023	-0.012723	0.016849	-0.734202	-0.001076	0.000630	-0.717799	22	-0.730522	4.4
23	4.6	0.003182	-0.012920	-0.001908	0.000926	-0.010720	0.014123	-1.281210	-0.000962	0.000561	-1.267488	23	-1.278208	4.6
24	4.8	0.002623	-0.010520	-0.001708	0.000819	-0.008785	0.011558	-2.262939	-0.000842	0.000489	-2.251734	24	-2.260519	4.8
25	5	0.002105	-0.008299	-0.001484	0.000704	-0.006975	0.009166	-3.637083	-0.000717	0.000415	-3.628219	25	-3.635194	5
26	5.2	0.001623	-0.006276	-0.001236	0.000580	-0.005310	0.006958	-4.085307	-0.000586	0.000338	-4.078597	26	-4.083907	5.2
27	5.4	0.001175	-0.004448	-0.000964	0.000447	-0.003790	0.004938	-2.558744	-0.000449	0.000258	-2.553998	27	-2.557789	5.4
28	5.6	0.000757	-0.002803	-0.000667	0.000306	-0.002408	0.003107	-1.009362	-0.000306	0.000175	-1.006387	28	-1.008795	5.6
29	5.8	0.000366	-0.001326	-0.000346	0.000157	-0.001149	0.001462	-0.276216	-0.000156	0.000089	-0.274821	29	-0.275971	5.8
30	6	0.000000	-0.000000	-0.000000	0.000000	-0.000000	-0.000000	0.000000	0.000000	-0.000000	0.000000	30	0.000000	6
31	6.2	-0.000343	0.001192	0.000369	-0.000164	0.001055	-0.001288	0.095174	0.000163	-0.000092	0.093957	31	0.095012	6.2
32	6.4	-0.000665	0.002266	0.000761	-0.000334	0.002028	-0.002411	0.122469	0.000334	-0.000187	0.120205	32	0.122233	6.4
33	6.6	-0.000967	0.003234	0.001173	-0.000510	0.002930	-0.003380	0.124352	0.000513	-0.000285	0.121201	33	0.124131	6.6
34	6.8	-0.001252	0.004110	0.001606	-0.000691	0.003773	-0.004204	0.117022	0.000699	-0.000386	0.113131	34	0.116904	6.8
35	7	-0.001519	0.004904	0.002056	-0.000876	0.004564	-0.004898	0.106839	0.000895	-0.000490	0.102345	35	0.106909	7
36	7.2	-0.001771	0.005625	0.002522	-0.001065	0.005310	-0.005471	0.096327	0.001099	-0.000598	0.091357	36	0.096667	7.2
37	7.4	-0.002009	0.006282	0.003001	-0.001257	0.006018	-0.005936	0.086452	0.001313	-0.000709	0.081120	37	0.087138	7.4
38	7.6	-0.002232	0.006881	0.003490	-0.001449	0.006690	-0.006304	0.077532	0.001537	-0.000823	0.071942	38	0.078632	7.6
39	7.8	-0.002443	0.007429	0.003988	-0.001643	0.007332	-0.006585	0.069613	0.001772	-0.000941	0.063859	39	0.071190	7.8