CHAPTER III

NUMBRICAE SOLUTION OF ELECTRIC FIELD

We shall calculate the electric field numerically in a special case from the Berkeley Physics Course formula, equations (2.41) and (2.42) and compare the result with that from the Feynman formula, equations (2.45) and (2.46), letting

$$q = 1, \quad a = 1, \quad x = -1(0.1)1, \quad v = c \sin 60^\circ$$

i.e. $$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} = 2$$

The Berkeley Physics Course formula

$$E_x = \frac{-\gamma q x}{\left[(\gamma x)^2 + y^2\right]^{3/2}} = \frac{-2x}{\left[4x^2 + 1\right]^{3/2}} \qquad \ldots\ldots(3.1)$$

$$E_y = \frac{-\gamma q y}{\left[(\gamma x)^2 + y^2\right]^{3/2}} = \frac{-2}{\left[4x^2 + 1\right]^{3/2}} \qquad \ldots\ldots(3.2)$$

The accuracy of E_x and E_y

The values tabulated in table 3.1 are accurate to the number of decimal places stated because the calculations were done on an electronics desk calculator which has eight singificant figures.

x	-2x	$(4x^2+1)^{3/2}$	E_x	E_y
-1.0	2.0	11.1803	0.1789	-0.1789
-0.9	1.8	8.7307	0.2062	-0.2291
-0.8	1.6	6.7170	0.2382	-0.2978
-0.7	1.4	5.0926	0.2749	-0.3927
-0.6	1.2	3.8114	0.3148	-0.5247
-0.5	1.0	2.8284	0.3536	-0.7071
-0.4	0.8	2.1002	0.3809	-0.9523
-0.3	0.6	1.5860	0.3783	-1.2610
-0.2	0.4	1.2494	0.3202	-1.6008
-0.1	0.2	1.0606	0.1886	-1.8857
0	0	1.0000	0	-2.0000
0.1	-0.2	1.0606	-0.1886	-1.8857
0.2	-0.4	1.2494	-0.3202	-1.6008
0.3	-0.6	1.5860	-0.3783	-1.2610
0.4	-0.8	2.1002	-0.3809	-0.9523
0.5	-1.0	2.8284	-0.3536	-0.7071
0.6	-1.2	3.8114	-0.3148	-0.5247
0.7	-1.4	5.0926	-0.2749	-0.3927
0.8	-1.6	6.7170	-0.2382	-0.2978
0.9	-1.8	8.7307	-0.2062	-0.2291
1.0	-2.0	11.1803	-0.1789	-0.1789

Table 3.1 Electric field from equation (3.1), (3.2)

Feynman's formula

From equations (2.45) and (2.46)

$$E_x = -q\left[\frac{x_R}{r_R^3} + \frac{r_R}{c}\frac{d}{dt}\left(\frac{x_R}{r_R^3}\right) + \frac{1}{c^2}\frac{d^2}{dt^2}\left(\frac{x_R}{r_R}\right)\right] \quad ..(2.45)$$

$$E_y = -q\left[\frac{y_R}{r_R^3} + \frac{r_R}{c}\frac{d}{dt}\left(\frac{y_R}{r_R^3}\right) + \frac{1}{c^2}\frac{d^2}{dt^2}\left(\frac{y_R}{r_R}\right)\right] \quad ...(2.46)$$

where x_R, y_R, r_R are given in (2.43) and (2.44) as

$$x_R = \left(1 - \frac{v^2}{c^2}\right)^{-1}\left\{vt - \frac{v}{c}\left(v^2t^2 + a^2\left(1 - \frac{v^2}{c^2}\right)\right)^{1/2}\right\}$$

$$y_R = a$$

$$r_R = \left(1 - \frac{v^2}{c^2}\right)^{-1}\left[v^2t^2 + \frac{v^2}{c^2}\left\{v^2t^2 + a^2\left(1 - \frac{v^2}{c^2}\right)\right\} - \right.$$

$$\left. 2\,\frac{v^2t}{c}\left\{v^2t^2 + a^2\left(1 - \frac{v^2}{c^2}\right)\right\}^{1/2} + a^2\left(1 - \frac{v^2}{c^2}\right)^2\right]^{1/2}$$

If $a = 1$, $v = c \sin 60°$

i.e. $\frac{v^2}{c^2} = \frac{3}{4} = 0.75 \Rightarrow 1 - \frac{v^2}{c^2} = \frac{1}{4} = 0.25$

and we have $x = Vt$.

Therefore,

$$x_R = 4\left\{x - \sin 60°\left(x^2 + \frac{1}{4}\right)^{1/2}\right\} = 4\left\{x - 0.866025\left(x^2 + 0.25\right)^{1/2}\right\} \quad ....(3.3)$$

$$r_R = 4\left\{x^2 + 0.75\left(x^2 + 0.25\right) - 1.732050x\left(x^2 + 0.25\right)^{1/2} + 0.0625\right\}^{1/2} \quad ...(3.4)$$

From Numerical Mathematical Analysis by J.B. Scarborough, page 134, we have the numerical differentiation formula

$$\left(\frac{dy}{dx}\right)_{x_0} = \frac{1}{\Delta x}\left[\frac{\Delta y_{-1} + \Delta y_0}{2} - \frac{1}{3!}\,\frac{\Delta^3 y_{-2} + \Delta^3 y_{-1}}{2} + \frac{4}{5!}\,\frac{\Delta^5 y_{-3} + \Delta^5 y_{-2}}{2} + \cdots\right] \qquad (3.5)$$

$$\left(\frac{d^2y}{dx^2}\right)_{x_0} = \frac{1}{(\Delta x)^2}\left[\Delta^2 y_{-1} - \frac{1}{12}\,\Delta^4 y_{-2} + \frac{8}{6!}\,\Delta^6 y_{-3} + \cdots\right] \qquad (3.6)$$

E_x and E_y are calculated in the following tables step by step.

x	ct	x_R	r_R
-1.1	-1.270171	-8.585688	8.643729
-1.0	-1.154701	-7.872982	7.936237
-0.9	-1.039231	-7.166509	7.235943
-0.8	-0.923761	-6.468025	6.544873
-0.7	-0.808291	-5.779931	5.865801
-0.6	-0.692821	-5.105549	5.202560
-0.5	-0.577351	-4.449489	4.560477
-0.4	-0.461880	-3.818106	3.946890
-0.3	-0.346410	-3.219900	3.371611
-0.2	-0.230940	-2.665475	2.846886
-0.1	-0.115470	-2.166351	2.386018
0	0	-1.732050	2.000000
0.1	0.115470	-1.366351	1.693198
0.2	0.230940	-1.065475	1.461246
0.3	0.346410	-0.819900	1.293151
0.4	0.461880	-0.618106	1.175610
0.5	0.577351	-0.449489	1.096378
0.6	0.692821	-0.305549	1.045642
0.7	0.808291	-0.179931	1.016063
0.8	0.923761	-0.068025	1.002316
0.9	1.039231	+0.033491	1.000567
1.0	1.154701	+0.127018	1.008042
1.1	1.270171	+0.214312	1.022715

Table 3.2 x_R and r_R calculated from (3.3) and (3.4)

From this table $\Delta(ct) = 0.115470$.

x_R	r_R	x_R/r_R	x_R/r_R^3	$1/r_R$	$1/r_R^3$
-8.585688	8.643729	-0.993285	-0.013294	0.115691	0.001548
-7.872982	7.936237	-0.992030	-0.015751	0.126004	0.002001
-7.166509	7.235943	-0.990404	-0.018916	0.138199	0.002639
-6.468025	6.544873	-0.988258	-0.023071	0.152791	0.003567
-5.779931	5.865801	-0.985361	-0.028638	0.170480	0.004955
-5.105549	5.202560	0.981353	-0.036257	0.192213	0.007101
-4.449489	4.560477	-0.975663	-0.046912	0.219275	0.010543
-3.818106	3.946890	-0.967371	-0.062099	0.253364	0.016264
-3.219900	3.371611	-0.955003	-0.084010	0.296594	0.026091
-2.665475	2.846886	-0.936277	-0.115522	0.351261	0.043340
-2.166351	2.386018	-0.907936	-0.159481	0.419108	0.073617
-1.732050	2.000000	-0.866025	-0.216506	0.500000	0.125000
-1.366351	1.693198	-0.806965	-0.281474	0.590598	0.206005
-1.065475	1.461246	-0.729155	-0.341486	0.684347	0.320501
-0.819900	1.293151	-0.634033	-0.379152	0.773305	0.462437
-0.618106	1.175610	-0.525775	-0.380429	0.850622	0.615475
-0.449489	1.096378	-0.409976	-0.341066	0.912094	0.758786
-0.305549	1.045642	-0.292212	-0.267259	0.956350	0.874684
-0.179931	1.016063	-0.177086	-0.171532	0.984191	0.953319
-0.068025	1.002316	-0.067868	-0.067555	0.997689	0.993084
+0.033491	1.000567	+0.033472	+0.033434	0.999433	0.998301
+0.127018	1.008042	+0.126005	+0.124002	0.992022	0.976257
+0.214312	1.022715	+0.209552	+0.200347	0.977790	0.934838

Table 3.3 $\frac{x_R}{r_R}$, $\frac{x_R}{r_R^3}$, $\frac{1}{r_R}$ and $\frac{1}{r_R^3}$ where x_r and r_R are from (3.3) and (3.4)

$f = {}^{xR}/{r^3_R}$	Δf	$\Delta^2 f$	$\Delta^3 f$	$\frac{1^{st}\text{ term of (3.7)}}{c}$	$\frac{2^{nd}\text{ term of (3.7)}}{c}$	$\frac{1}{c}\frac{d}{dt}\left(\frac{x_R}{r^3_R}\right)$
-0.013294	- 2457					
-0.015751	- 3165	- 708	- 282	-0.024344		
-0.018916	- 4155	- 990	- 422	-0.031697	-0.000508	-0.031189
-0.023071	- 5567	- 1412	- 640	-0.042098	-0.000766	-0.041332
-0.028638	- 7619	- 2052	- 984	-0.057097	-0.001172	-0.055925
-0.036257	-10655	- 3036	- 1496	-0.079129	-0.001790	-0.077339
-0.046912	-15187	- 4532	- 2192	-0.111899	-0.002662	-0.109237
-0.062099	-21911	- 6724	- 2877	-0.160639	-0.003658	-0.156981
-0.084010	-31512	- 9601	- 2846	-0.231328	-0.004130	-0.227198
-0.115522	-43959	-12447	- 619	-0.326799	-0.002501	-0.324298
-0.159481	-57025	-13066	+ 5123	-0.437274	+0.003250	-0.440524
-0.216506	-64968	- 7943	+12899	-0.528245	+0.013006	-0.541251
-0.281474	-60012	+ 4956	+17390	-0.541180	+0.021859	-0.563039
-0.341486	-37666	+22346	+14043	-0.422958	+0.022685	-0.445643
-0.379152	- 1277	+36389	+ 4251	-0.168628	+0.013203	-0.181831
-0.380429	+39363	+40640	- 6196	+0.164913	-0.001404	+0.166317
-0.341066	+73807	+34444	-12524	+0.490040	-0.013510	+0.503550
-0.267259	+95727	+21920	-13670	+0.734104	-0.018904	+0.753008
-0.171532	+103977	8250	-11238	+0.864744	-0.017976	+0.882720
-0.067555	+100989	- 2988	- 7433	+0.887529	-0.013475	+0.901004
+0.033434	+ [illegible]568	-10421	- 3802	+0.829467	-0.008108	+0.837575
+0.124002	+ 76345	-14223		+0.722755		
+0.200347						

Table 3.4 $\frac{1}{c}\frac{d}{dt}\left(\frac{x_R}{r^3_R}\right)$ calculated by using the formula (3.5)

Thus : $$\left(\frac{df}{dt}\right)_{t_0} = \frac{c}{0.230940}\left(\Delta f_{-1} + \Delta f_0\right) - \frac{c}{1.385640}\left(\Delta^3 f_{-2} + \Delta^3 f_{-1}\right) + \dots \quad (3.7)$$

$x_R/r_R = \xi$	$\Delta\xi$	$\Delta^2\xi$	$\Delta^3\xi$	$\Delta^4\xi$	$\frac{1^{st}\text{ term of (3.8)}}{c^2}$	$\frac{2^{nd}\text{ term of (3.8)}}{c^2}$	$\frac{1}{c^2}\frac{d^2}{dt^2}\left(\frac{x_R}{r_R}\right)$
-0.993285							
	1255						
-0.992030		371					
	1626		149				
-0.990404		520		82	-0.039001	0.000512	0.038489
	2146		231				
-0.988258		751		129	0.056326	0.000806	0.055520
	2897		360				
-0.985361		1111		211	0.083327	0.001319	0.082008
	4008		571				
-0.981353		1682		349	0.126153	0.002181	0.123972
	5690		920				
-0.975663		2602		554	0.195155	0.003462	0.191693
	8292		1474				
-0.967371		4076		808	0.305708	0.005050	0.300658
	12368		2282				
-0.955003		6358		975	0.476862	0.006094	0.470768
	18726		3257				
-0.936277		9615		698	0.721143	0.004362	0.716781
	28341		3955				
-0.907936		13570		- 376	1.017775	-0.002350	1.020125
	41911		3579				
-0.866025		17149		-1978	1.286207	-0.012362	1.298569
	59060		1601				
-0.806965		18750		-3039	1.406285	-0.018994	1.425279
	77810		-1438				
-0.729155		17312		-2738	1.298432	-0.017112	1.315544
	95122		-4176				
-0.634033		13136		-1419	0.985225	-0.008869	0.994094
	108258		-5595				
-0.525775		7541		+ 19	0.565589	0.000119	0.565470
	115799		-5576				
-0.409976		1965		+ 973	0.147379	0.006081	0.141298
	117764		-4603				
-0.292212		- 2638		+1333	-0.197855	0.008331	-0.206186
	115126		-3270				
-0.177086		- 5908		+1300	-0.443111	0.008125	-0.451236
	109218		-1970				
-0.067868		- 7878		+1041	-0.590865	0.006506	-0.597371
	101340		- 929				
+0.033472		- 8807		+ 750	-0.660542	0.004688	-0.665230
	92533		- 179				
+0.126005		- 8986			-0.673967		
	83547						
+0.209552							

Table 3.5 $\frac{1}{c^2}\frac{d^2}{dt^2}\left(\frac{x_R}{r_R}\right)$ calculated from the formula (3.6)

Thus : $\left(\frac{d^2\xi}{dt^2}\right) = \frac{c^2\Delta^2\xi_{3-1}}{\ } - \frac{c^2\Delta^4\xi_{3-2}}{\ }$ (3.8)

$\frac{1}{r_R^3} = g$	Δg	$\Delta^2 g$	$\Delta^3 g$	$\frac{1^{st}\text{ term of (3.9)}}{c}$	$\frac{2^{nd}\text{ term of (3.9)}}{c}$	$\frac{1}{c}\frac{d}{dt}\left(\frac{1}{r_R^3}\right)$
0.001548	453					
0.002001	638	185	105	0.004724		
0.002639	928	290	170	0.006781	0.000199	0.006582
0.003567	1388	460	298	0.010029	0.000338	0.009691
0.004955	2146	758	538	0.015303	0.000604	0.014699
0.007101	3442	1296	983	0.024197	0.001098	0.023099
0.010543	5721	2279	1827	0.039677	0.002028	0.037649
0.016264	9827	4106	3316	0.067325	0.003712	0.063613
0.026091	17249	7422	5606	0.117243	0.006439	0.110804
0.043340	30277	13028	8078	0.205794	0.009876	0.195918
0.073617	51383	21106	8516	0.353599	0.011976	0.341623
0.125000	81005	29622	3869	0.573258	0.008939	0.564319
0.206005	114496	33491	- 6051	0.846545	-0.001575	0.848120
0.320501	141936	27440	-16338	1.110384	-0.016158	1.126542
0.462437	153038	11102	-20829	1.277276	-0.026823	1.304099
0.615475	143311	- 9727	-17686	1.283230	-0.027796	1.311026
0.758786	115898	-27413	- 9850	1.122409	-0.019873	1.142282
0.874684	78635	-37263	- 1607	0.842353	-0.008269	0.850622
0.953319	39765	-38870	+ 4322	0.512688	+0.001960	0.510728
0.993084	5217	-34548	+ 7287	0.194778	0.008378	0.186400
0.998301	- 22044	-27261	+ 7886	-0.072863	0.010951	-0.083814
0.976257	- 41419	-19375		-0.274803		
0.934838						

Table 3.6 $\frac{1}{c}\frac{d}{dt}\left(\frac{1}{r_R^3}\right)$ calculated from the formula (3.5),

Thus : $\left(\frac{dg}{dt}\right)_{to} = \frac{c}{0.230940}\left(\Delta g_1 + \Delta g_o\right) - \frac{c}{1.385640}\left(\Delta^3 g_{-2} + \Delta^3 g_{-1}\right) + \ldots$ (3.9)

$\frac{1}{r_R} = \xi$	$\Delta \xi$	$\Delta^2 \xi$	$\Delta^3 \xi$	$\Delta^4 \xi$	$\frac{1^{st}\text{ term of (3.10)}}{c^2}$	$\frac{2^{nd}\text{ term of (3.10)}}{c^2}$	$\frac{1}{c^2}\frac{d^2}{dt^2}(\frac{1}{r_R})$
0.115691							
	10313						
-.126004		1882					
	12195		515				
0.138199		2397		185	0.179780	0.001157	0.178623
	14592		700				
0.152791		3097		247	0.232281	0.001544	0.230737
	17689		947				
0.170480		4044		338	0.303308	0.002113	0.301195
	21733		1285				
0.192213		5329		413	00.399685	0.002582	0.397103
	27062		1698				
0.219275		7027		416	0.527039	0.002600	0.524439
	34089		2114				
0.253364		9141		182	0.685593	0.001138	0.684455
	43230		2296				
0.296594		11437		- 553	0.857797	-0.003457	0.861254
	54667		1743				
0.351261		13180		-1878	0.988525	-0.011738	1.000263
	67847		- 135				
0.419108		13045		-3204	0.978400	-0.020025	0.998425
	80892		-3339				
0.500000		9706		-3216	0.727969	-0.020100	0.748069
	90598		-6555				
0.590598		3151		-1387	0.236331	-0.008669	0.245000
	93749		-7942				
0.684347		- 4791		+1092	-0.359334	+0.006825	-0.366159
	88958		-6850				
0.773305		-11641		+2646	-0.873097	+0.016538	-0.889635
	77317		-4204				
0.850622		-15845		+2833	-1.188405	+0.017707	-1.206112
	61472		-1371				
0.912094		-17216		+2172	-1.291233	+0.013575	-1.304808
	44256		+ 801				
0.956350		-16415		+1271	-1.231156	+0.007944	-1.239100
	27841		+2072				
0.984191		-14343		+ 517	-1.075752	+0.003232	-1.078984
	13498		+2589				
0.997689		-11754		+ 10	-0.881572	+0.000063	-0.881635
	1744		+2599				
0.999433		- 9155		- 265	-0.686643	-0.001657	-0.684986
	- 7411		+2334				
0.992022		- 6821			-0.511588		
	-14232						
0.977790							

Table 3.7 $\frac{1}{c^2}\frac{d^2}{dt^2}(\frac{1}{r_R})$ which calculated from the formula (3.6),

Thus : $\left(\frac{d^2 \xi}{\ldots}\right) = \frac{c^2 \Delta^2 \xi_{j-1}}{\ldots} - \frac{c^2 \Delta^4 \xi_{j-2}}{\ldots} + \ldots$ (3.10)

x	x_R / r_R^3	$\frac{1}{c} \frac{d}{dt} (\frac{x_R}{r_R^3})$	$\frac{r_R}{c} \frac{d}{dt} (\frac{x_R}{r_R^3})$	$\frac{1}{c^2} \frac{d^2}{dt^2} (\frac{x_R}{r_R})$	E_x
-1.1	-0.013294				
-1.0	-0.015751	-0.024344	-0.193200		
-0.9	-0.018916	-0.031189	-0.225682	0.038489	+0.206109
-0.8	-0.023071	-0.041332	-0.270513	0.055520	0.238064
-0.7	-0.028638	-0.055925	-0.328045	0.082008	0.274675
-0.6	-0.036257	-0.077339	-0.402361	0.123972	0.314646
-0.5	-0.046912	-0.109237	-0.498173	0.191693	0.353392
-0.4	-0.062099	-0.156981	-0.619587	0.300658	0.381028
-0.3	-0.084010	-0.227198	-0.766024	0.470768	0.379266
-0.2	-0.115522	-0.324298	-0.923240	0.716781	0.321981
-0.1	-0.159481	-0.440524	-1.051099	1.020125	0.190455
0	-0.216506	-0.541251	-1.082502	1.298569	0.000439
0.1	-0.281474	-0.563039	-0.953337	1.425279	-0.190468
0.2	-0.341486	-0.445643	-0.651194	1.315544	-0.322864
0.3	-0.379152	-0.181831	-0.235135	0.994094	-0.379807
0.4	-0.380429	+0.166317	+0.195524	0.565470	-0.380565
0.5	-0.341066	+0.503550	+0.552081	0.141298	-0.352313
0.6	-0.267259	+0.753008	+0.787377	-0.206186	-0.313932
0.7	-0.171532	+0.882720	+0.896900	-0.451236	-0.274132
0.8	-0.067555	+0.901004	+0.903091	-0.597371	-0.238165
0.9	+0.033434	+0.837575	+0.838050	-0.665230	-0.206254
1.0	+0.124002	+0.722755	+0.728568		
1.1	+0.200347				

Table 3.8 E_x calculated from the formula (2.45)

x	$1/r_R^3$	$\frac{r_R}{c}\frac{d}{dt}\left(\frac{1}{r_R^3}\right)$	$\frac{1}{c^2}\frac{d^2}{dt^2}\left(\frac{1}{r_R}\right)$	E_y
-1.1	0.001548			
-1.0	0.002001	0.037491		
-0.9	0.002639	0.047627	0.178623	-0.228889
-0.8	0.003567	0.063427	0.230737	-0.297731
-0.7	0.004955	0.086222	0.301195	-0.392372
-0.6	0.007101	0.120174	0.397103	-0.524378
-0.5	0.010543	0.171698	0.524439	-0.706680
-0.4	0.016264	0.251074	0.684455	-0.951793
-0.3	0.026091	0.373588	0.861254	-1.260933
-0.2	0.043340	0.557757	1.000263	-1.601360
-0.1	0.073617	0.815119	0.998425	-1.887161
0	0.125000	1.128638	0.748069	-2.001707
0.1	0.206005	1.436035	0.245000	-1.887040
0.2	0.320501	1.646155	-0.366159	-1.600497
0.3	0.462437	1.686397	-0.889635	-1.259199
0.4	0.615475	1.541256	-1.206112	-0.950619
0.5	0.758786	1.252373	-1.304808	-0.706351
0.6	0.874684	0.889446	-1.239100	-0.525030
0.7	0.953319	0.518932	-1.078984	-0.393267
0.8	0.993084	0.186832	-0.881635	-0.298281
0.9	0.998301	-0.083862	-0.684986	-0.229453
1.0	0.976257	-0.277013		
1.1	0.934838			

Table 3.9 E_y calculated from the formula (2.46)

x	ct	x_R	From table 3.1 (B-rkeley's)		From table 3.8;3.9 (Feynman's)		$E=\sqrt{E_x^2+E_y^2}$
			E_x	E_y	E_x	E_y	
-1.0	-1.15	-7.87	0.1789	-0.1789			0.2530
-0.9	-1.04	-7.17	0.2062	-0.2291	0.21	-0.23	0.3082
-0.8	-0.92	-6.47	0.2382	-0.2978	0.24	-0.30	0.3813
-0.7	-0.81	-5.78	0.2749	-0.3927	0.27	-0.39	0.4794
-0.6	-0.69	-5.11	0.3148	-0.5247	0.31	-0.52	0.6119
-0.5	-0.58	-4.45	0.3536	-0.7071	0.35	-0.71	0.7906
-0.4	-0.46	-3.82	0.3809	-0.9523	0.38	-0.95	1.0257
-0.3	-0.35	-3.22	0.3783	-1.2610	0.38	-1.26	1.3165
-0.2	-0.23	-2.67	0.3202	-1.6008	0.32	-1.60	1.6325
-0.1	-0.12	-2.17	0.1886	-1.8857	0.19	-1.89	1.9778
0	0	-1.73	0	-2.0000	0	-2.00	2.0000
0.1	0.12	-1.37	-0.1886	-1.8857	-0.19	-1.89	1.9778
0.2	0.23	-1.07	-0.3202	-1.6008	-0.32	-1.60	1.6325
0.3	0.35	-0.82	-0.3783	-1.2610	-0.38	-1.26	1.3165
0.4	0.46	-0.62	-0.3809	-0.9523	-0.38	-0.95	1.0257
0.5	0.58	-0.45	-0.3536	-0.7071	-0.35	-0.71	0.7906
0.6	0.69	-0.31	-0.3148	-0.5247	-0.31	-0.53	0.6119
0.7	0.81	-0.18	-0.2749	-0.3927	-0.27	-0.39	0.4794
0.8	0.92	-0.68	-0.2382	-0.2978	-0.24	-0.30	0.3813
0.9	1.04	+0.03	-0.2062	-0.2291	-0.21	-0.23	0.3082
1.0	1.15	+0.13	-0.1789	-0.1789			0.2530

Table 3.10 Summary of the results.

The accuracy of E_x and E_y

The electric field calculated from the equation (2.45) and (2.46)

$$E_x = -q \left[\frac{x_R}{r_R^3} + \frac{r_R}{c} \frac{d}{dt} \left(\frac{x_R}{r_R^3} \right) + \frac{1}{c^2} \frac{d^2}{dt^2} \left(\frac{x_R}{r_R} \right) \right] \quad \ldots(2.45)$$

$$E_y = -q \left[\frac{y_R}{r_R^3} + \frac{r_R}{c} \frac{d}{dt} \left(\frac{y_R}{r_R^3} \right) + \frac{1}{c^2} \frac{d^2}{dt^2} \left(\frac{y_R}{r_R} \right) \right] \quad \ldots(2.46)$$

is accurate to one decimal place for the following reason.

Formulas (3.5) and (3.6) were used to calculated the first and second derivatives in (2.45) and (2.46). For all cases calculations showed that the third term in formulas (3.5) and (3.6) were less than 0.005 and the higher order terms were even smaller. And in the second terms of E_x and E_y, when the first derivative which is accurate to two decimal places is multiplied by r_R (which is less than 10 and greater than 1), the result has an accuracy of only one decimal place.

Since the first terms and the third terms of E_x and E_y have accuracy greater than one decimal place, it follows that E_x and E_y are accurate to one decimal place.