

討論会記録

Ⅲ 「類数の問題」の部

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こゝでは、問題点として次のようなことがあげられる。

1. 類数公式

類数公式，極限公式については基礎的な文献としては

Hasse [8], 本田 [2], Siegel [2], [4], 高木 [1],

[2] など。

他に

(i) K の代数体 K の類数 h_K の関係: Brauer [2],

Kuroda [2].

(ii) 類数 h_K の評価: Brauer [1], Newman [1],

Siegel [1].

2. 類数 (またはイデアル類群) については 1930 年

information などは。

解説的な文献としては

Narkiewicz [2], 横井 [4] など

また, 2 種の問題, 典型として, Genus Theory として
Cohn [1], Siegel [4].

(i) Γ -拡大の類数として: Iwasawa [3].

(ii) イデール群の階数評価: Roquette-Zassenhaus [1].

(iii) 類数の可除性, 非可除性: Honda [5], Ishida [2],
Iwasawa [1].

(iv) Γ による (可除性の) 類数と, 代数体の存在. 構成:
Yamamoto [1].

3. Γ による類数と代数体の決定, その他.

(i) 類数 1 の度二次体の決定: Baker [2], Bundschuh-
Hock [1], Siegel [3], Stark [2]

(ii) 類数 2 の度二次体の決定として, 部分的な結果:

Iseki [1], Tatzawa [1], Seminar Note at Stony Brook.

(iii) 類数 1 の度二次体が無限に多く存在する (Gauß
の予想)

(iv) 円分体 $\mathbb{Q}(\exp \frac{2\pi i}{l})$ (l : 素数) の類数は $l > 23$ ならば
1 より大きく (Siegel の予想): Siegel [4], [5]

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of the quadratic field $Q(\sqrt{-m})$,
 $1 \leq m < 24000$.

by Hideo Wada

$h_{i,j} = h(Q(\sqrt{-m})), m = i + 100j$

	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	
1	48	20	64	48	...	56	...	48	60	52	51	18	...	7	63	8	41	26	40	11	54	29	28	27	26	25	24	23	22	21	20
2	16	26	20	16	40	...	26	48	24	18	53	18	32	36	16	52	24	24	28	...	24	54	40	28	24	24	24	24	24	24	24
3	9	34	5	...	...	21	20	28	9	59	54	72	40	...	56	32	38	48	...	26	80	...	...	...	...	...	...	...	...	...	...
5	32	48	...	24	40	40	16	72	48	24	55	28	12	40	12	28	12	...	8	60	12	12	8	...	...	...	...	...	...	...	...
6	48	...	32	64	60	32	60	32	36	66	57	...	24	24	42	...	18	32	44	20	54	...	...	...	...	...	...	...	...	...	...
7	...	...	39	8	20	14	28	7	52	...	58	...	20	28	...	...	64	24	24	38	32	...	...	...	...	...	...	...	...	...	...
9	...	40	...	66	40	28	84	...	...	70	59	8	60	...	...	18	40	13	54	18	40	...	...	...	...	...	...	...	...	...	...
10	32	28	56	32	16	52	...	24	40	40	61	...	36	72	36	36	64	48	28	66	...	...	...	...	...	...	...	...	...	...	...
11	7	49	16	29	23	...	8	53	16	42	62	12	56	24	26	32	24	...	26	...	16	...	...	...	...	...	...	...	...	...	...
13	16	16	42	...	24	32	24	24	60	28	63	45	8	22	10	34	6	43	...	22	13	...	...	...	...	...	...	...	...	...	...
14	36	56	...	...	72	40	46	80	40	24	65	24	28	32	32	32	...	32	56	32	20	...	...	...	...	...	...	...	...	...	...
15	52	...	22	18	40	6	46	8	22	24	66	56	...	36	...	...	18	68	28	40	86	...	...	...	...	...	...	...	...	...	...
17	12	36	28	24	36	24	32	32	...	22	67	8	18	11	...	7	44	8	21	12	44	...	...	...	...	...	...	...	...	...	...
18	28	20	26	36	24	30	40	...	20	34	69	38	...	30	72	52	32	64	40	40	52	...	...	...	...	...	...	...	...	...	...
19	16	34	24	30	8	64	...	41	21	40	70	...	16	28	24	32	44	40	36	56	...	...	...	...	...	...	...	...	...	...	...
21	68	40	18	60	...	32	62	52	32	64	71	30	14	44	13	62	14	23	26	...	11	...	...	...	...	...	...	...	...	...	...
22	24	18	52	...	20	36	24	20	48	44	73	20	20	48	24	20	44	...	16	...	28	...	...	...	...	...	...	...	...	...	...
23	...	14	...	8	33	...	22	12	26	6	74	20	64	56	22	78	...	32	56	40	48	...	...	...	...	...	...	...	...	...	...
26	34	60	40	22	54	60	36	68	...	40	77	16	40	...	16	38	20	22	40	40	24	...	...	...	...	...	...	...	...	...	...
27	11	28	6	48	14	...	12	...	8	31	78	40	...	24	60	32	16	40	36	16	60	...	...	...	...	...	...	...	...	...	...
29	34	56	48	32	56	...	24	80	32	40	79	...	7	56	16	24	21	52	14	57	...	...	...	...	...	...	...	...	...	...	...
30	40	32	20	60	...	24	60	32	20	28	81	60	36	20	38	52	36	72	...	28	80	...	...	...	...	...	...	...	...	...	...
31	38	13	58	...	28	17	48	11	68	14	82	24	22	40	28	24	50	...	28	64	24	...	...	...	...	...	...	...	...	...	...
33	28	...	16	34	44	60	32	32	84	...	83	7	42	6	29	20	...	5	...	20	20	...	...	...	...	...	...	...	...	...	...
34	...	32	34	44	32	60	36	28	...	...	85	32	24	60	...	24	40	24	32	36	32	...	...	...	...	...	...	...	...	...	...
35	8	44	12	14	22	...	12	62	...	22	86	24	42	...	32	56	56	32	72	40	30	...	...	...	...	...	...	...	...	...	...
37	24	16	30	32	18	60	...	16	46	24	87	35	...	29	12	20	8	51	6	25	20	...	...	...	...	...	...	...	...	...	...
38	18	42	28	24	28	...	20	...	40	24	89	44	60	32	34	44	32	24	82	...	...	...	...	...	...	...	...	...	...	...	...
39	45	8	35	19	...	11	64	16	58	28	90	48	24	20	48	32	24	60	...	...	...	...	...	...	...	...	...	...	...	...	...
41	32	78	...	30	76	...	20	53	44	40	91	12	30	18	34	12	57	...	39	...	48	...	...	...	...	...	...	...	...	...	...
42	50	...	16	42	32	16	52	32	...	40	93	40	24	14	60	...	24	42	...	16	48	...	...	...	...	...	...	...	...	...	...
43	...	13	15	32	6	35	10	20	15	...	94	28	32	76	...	20	44	60	24	68	64	...	...	...	...	...	...	...	...	...	...
45	48	32	32	56	32	24	...	...	32	64	95	16	16	...	8	56	12	...	12	36	8	...	...	...	...	...	...	...	...	...	...
46	32	28	78	24	28	64	...	38	72	32	97	...	...	40	32	28	...	24	18	36	...	...	...	...	...	...	...	...	...	...	...
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6	192	...	56	112	128	64	192	120	...	96	55	52	88	23	132	...	72	64	56	28
7	...	84	208	128	72	140	136	114	108	...	57	74	120	...	44	114	92	58	132	96
9	58	25	92	20	131	36	68	...	...	18	58	76	...	68	140	116	...	128	64	82
10	128	72	120	120	72	196	...	88	168	168	59	...	38	172	40	99	...	138	25	168
11	88	152	80	68	108	...	64	208	120	56	61	240	72	80	196	84	110	200	...	68
13	45	164	19	200	...	...	63	140	36	165	62	56	76	120	...	50	120	...	52	156
14	74	116	...	80	...	64	42	168	80	64	63	23	118	26	...	33	...	20	133	24
15	168	...	72	240	104	100	204	112	76	186	65	96	80	132	...	80	120	104	72	128
17	...	32	190	...	54	36	128	16	206	...	66	108	...	...	82	224	112	122	...	160
18	72	92	...	142	...	54	116	...	56	144	67	132	...	56	57	96	18	75	32	54
19	23	...	40	80	54	160	...	42	130	64	69	60	270	176	120	136	88	92	124	...
21	...	84	150	...	80	168	116	80	174	108	70	96	88	100	112	144	80	112	...	...
22	48	176	...	56	84	80	68	142	68	80	71	156	48	130	64	32	196	...	103	62
23	87	...	54	25	112	25	132	20	66	34	73	80	72	48	120	...	44	154	80	56
26	168	112	94	172	120	92	164	...	120	144	74	136	72	184	...	80	142	88	104	182
27	32	44	49	66	28	124	...	95	40	72	77	88	46	140	52	92	144	96	44	108
29	192	124	128	144	...	92	176	100	80	256	79	...	112	72	54	98	84	56	182	...
30	80	60	144	...	76	148	96	56	176	144	81	132	160	152	84	228	...	72	224	88
31	121	68	...	34	122	48	74	72	152	36	82	96	96	54	140	...	60	126	72	60
33	...	72	112	64	76	96	124	60	104	...	83	72	19	139	...	46	45	68	20	124
34	96	156	120	94	220	104	84	202	...	132	85	60	...	64	148	64	84	120	96	112
35	44	92	20	168	32	100	62	...	16	104	86	152	...	...	148	80	152	132	80	248
37	48	112	112	60	104	...	72	72	52	128	87	...	76	...	41	37	90	25	148	...
38	164	104	64	84	...	...	64	96	96	60	87	119	118	64	176	176	102	...	96	136
39	94	37	140	...	90	52	112	25	195	32	89	112	64	192	128	88	104	...	76	136
41	200	...	132	158	136	84	176	96	120	256	91	20	145	36	87	45	...	42	184	28
42	...	...	112	100	40	134	84	56	88	...	93	72	68	180	...	82	120	96	56	90
43	18	111	32	68	24	68	26	104	...	67	94	88	...	...	72	160	144	112	160	136
45	128	56	112	72	72	208	...	96	168	96	95	144	80	64	76	20	80	28	96	52
46	76	208	116	92	250	...	72	208	160	66	97	...	104	88	90	64	48	124	...	74
47	142	32	47	33	...	14	123	24	54	48	98	128	60	56	120	68	72	168	...	80
49	96	150	...	116	144	120	124	203	124	68	99	32	124	...	108	25	179	...	69	164

	230	231	232	233	234	235	236	237	238	239
1	160	72	292	...	112	124	92	120	204	136
2	56	104	...	52	102	100	72	156	76	56
3	43	...	19	108	28	70	47	58	30	156
5	80	136	128	80	128	120	72	160	...	72
6	136	168	104	284	96	96	160	...	120	148
7	100	24	126	24	72	36	...	30	116	24
9	216	96	116	256	...	94	212	96	64	154
10	80	80	160	...	100	104	96	52	172	128
11	35	...	...	97	78	140	34	206	30	131
13	...	72	92	88	60	176	88	72	150	...
14	124	184	136	64	224	100	120	216	...	68
15	138	24	78	62	80	26	126	...	80	50
17	60	178	112	52	100	...	88	96	120	70
18	84	100	88	88	...	68	...	72	42	140
19	66	124	48	...	26	184	36	87	81	128
21	190	...	88	168	160	84	192	148	104	204
22	...	64	148	...	...	88	64	68	116	...
23	64	32	68	26	94	26	53	44	...	18
26	116	224	...	92	192	...	66	268	...	72
27	39	60	21	153	...	56	37	80	21	122
29	74	192	...	96	240	128	78	248	...	88
30	...	...	72	124	80	72	192	96	60	116
31	...	27	234	40	71	53	158	26	177	...
33	192	96	48	110	56	56	96	...	84	104
34	96	92	160	136	90	...	...	114	232	132
35	24	172	24	60	64	...	36	192	32	82
37	72	64	108	...	60	136	84	64	...	64
38	48	136	...	72	100	48	96	112	112	80
39	165	...	114	69	144	43	200	28	108	62
41	72	280	96	112	220	128	72	198	...	64
42	168	64	46	108	112	60	106	...	72	130
43	32	61	52	88	20	128	...	65	40	120
45	128	104	120	160	...	48	152	104	96	184
46	112	92	164	...	72	252	160	72	126	136
47	64	34	...	18	123	40	48	49	110	20
49	...	84	180	128	124	170	180	96	160	...
	230	231	232	233	234	235	236	237	238	239
	68	92	29	198	50	102	82	...	28	132
	66	...	112	...	124	...	48	96	60	96
	180	160	96	170	...	96	150	112	132	232
	55	88	32	108	76	52	88	28	196	36
	104	...	64	142	80	58	112	120	40	138
	...	46	104	104	60	138	108	72	128	...
	29	171	36	104	59	134	34	150	...	92
	164	104	196	112	92	204	...	104	228	...
	64	172	68	76	190	...	44	...	72	66
	161	36	52	30	...	17	183	...	...	34
	88	144	...	84	...	88	96	...	96	60
	176	...	88	228	96	92	180	104	142	224
	...	57	52	64	18	111	...	57	50	...
	144	148	86	196	160	...	198	...	122	212
	96	64	120	80	92	180	...	100	160	64
	105	52	174	37	...	...	71	64	96	47
	60	66	...	...	56	140	96	66	136	96
	96	158	...	96	...	108	104	168	96	94
	80	...	68	64	160	56	98	136	...	60
	168	72	72	156	80	62	96	...	58	124
	...	30	141	46	94	80	...	40	135	32
	112	88	88	132	...	142	144	164	72	218
	84	68	152	...	60	140	112	80	122	72
	14	170	...	100	44	104	18	82	36	50
	...	56	132	128	64	128	80	64	128	...
	80	124	140	96	160	176	88	148	...	120
	121	32	84	36	66	16	161	...	83	...
	100	226	136	64	108	...	120	242	140	96
	108	128	56	188	...	72	176	96	68	144
	56	84	47	...	...	186	36	110	80	96
	120	...	70	120	72	56	128	80	66	124
	...	110	228	120	100	224	112	60	256	...
	64	56	124	16	196	...	76	32	...	24
	84	62	124	112	72	152	...	40	160	72
	74	112	80	46	184	...	...	140	104	...
	85	104	32	229	...	65	52	168	27	242

The Table of
Ideal groups of $Q(\sqrt{-m})$, $0 < m < 24000$, which are not trivial groups.

Let t be the number of ramified primes at $Q(\sqrt{-m})/Q$. Then

'trivial group' means

1) cyclic, when $t=1$ or 2,

2) of $(a, 2, 2, \dots, 2)$ type, when $t \geq 3$.

In this table, ' $a*b*c$ ' means a group of (a, b, c) type. The first number m , such that the ideal group of $Q(\sqrt{-m})$ is not trivial group, is 974.

m	G	m	G	m	G	m	G	m	G
974	12*3	5703	18*3	10549	8*4*2	8522	30*3	13143	16*4
1513	4*4	5795	8*4	10605	4*4*2*2	8555	8*4	13317	8*4*2
1582	4*4	5857	12*3	10718	16*4	8633	16*4	13342	12*4
1590	4*4*2	5910	4*4*2	10759	12*4	8638	8*4	13359	24*4
1598	8*4	5986	8*4	10790	12*4*2	8671	16*4	13398	4*4*2*2
1886	16*4	6001	8*4	10798	12*3	8701	8*4*2	13677	8*4*2
1918	4*4	6014	24*4	10803	4*4	8710	4*4*2	13678	8*4
2329	8*4	6085	6*6	10961	32*4	8738	16*4	13727	28*4
2379	4*4	6123	4*4	11001	6*6*2	8751	24*3	13817	28*4
2437	6*3	6221	42*3	11199	20*5	8790	8*4*2	13829	54*3
2542	4*4	6226	12*6	11326	24*4	8878	8*4	13906	16*4
2702	12*4	6286	12*4	11534	44*4	8942	24*4	14033	36*3
2993	12*4	6355	4*4	11651	18*3	8974	16*4	14062	12*4
3026	12*4	6398	16*4	11713	4*4*2	9069	12*6	14126	36*4
3262	8*4	6402	4*4*2	11822	20*4	9118	8*4	14155	4*4
3299	9*3	6494	24*4	11966	32*4	9214	16*4	14162	20*4
3358	8*4	6497	8*8	12002	20*4	9266	36*4	14334	18*6
3502	4*4	6583	12*3	12013	6*6	9385	12*6	14446	20*4
3886	6*6	6690	6*6*2	12067	6*3	9422	24*4	14462	24*4
3934	8*4	6789	6*6*2	12095	32*4	9497	24*3	14473	12*4
4027	3*3	6910	6*6	12118	6*6	9503	20*4	14547	4*4
4318	8*4	6914	36*3	12131	12*3	9510	8*4*2	14606	10*10
4369	12*4	6953	16*4	12206	48*4	9554	40*4	14637	4*4*2*2
4486	10*5	7006	20*4	12207	20*4	9574	18*3	14722	8*4
4633	8*4	7059	8*4	12282	6*6*2	9595	4*4	14730	6*6*2
4658	16*4	7081	16*4	12394	18*3	9673	12*4	14795	8*4
4718	16*4	7361	28*4	12451	5*5	9809	32*4	15049	12*6
4777	8*4	7582	8*4	12453	6*6*2	9881	28*4	15326	48*4
4810	4*4*2	7585	4*4*2	12481	12*6	9934	12*3	15389	20*10
4895	16*4	7769	24*4	12505	8*4*2	9955	4*4	15538	16*4
5037	4*4*2	7966	8*8	12595	4*4	10001	40*4	15549	12*4*2
5069	12*6	7977	6*6	12638	32*4	10015	18*3	15655	24*4
5134	16*4	8103	12*4	12710	16*4*2	10074	8*4*2	15658	10*5
5142	6*6	8126	40*4	12837	6*6*2	10081	12*4	15742	16*4
5190	8*4*2	8242	6*6	12937	8*4	10173	6*6	15805	8*4*2
5306	12*6	8322	8*4*2	12994	12*4	10295	32*4	15806	44*4
5417	24*3	8366	28*4	13022	16*4	10366	16*4	15910	8*4*2
5614	8*4	8446	12*4	13073	16*4	10414	20*4	15929	32*4

m	G	m	G	m	G	m	G
15934	16*4	18458	18*6	21098	16*4*2	23439	36*4
16049	30*6	18542	28*4	21190	8*4*2	23585	16*4*2
16201	20*4	18555	6*6	21233	28*4	23605	12*6
16238	12*12	18649	16*4	21243	8*4	23683	6*3
16301	78*3	18721	32*4	21395	16*4	23862	6*6*2
16441	28*4	18761	32*4	21418	18*3	23871	24*4
16446	10*10	18814	20*4	21449	24*6	23910	8*8*2
16582	10*5	18922	10*5	21454	24*4	23953	24*4
16609	24*4	19187	12*3	21571	8*4		
16627	6*3	19286	42*3	21605	24*4*2		
16710	8*4*2	19346	44*4	21755	16*4		
16769	28*4	19427	9*3	21895	24*4		
16782	10*10	19545	6*6*2	21922	20*4		
16814	48*4	19590	12*4*2	21930	6*6*2*2		
16870	6*6*2	19618	12*4	21998	20*4		
16887	24*4	19651	6*3	22055	40*4		
16895	24*4	19677	6*6*2	22127	16*8		
17131	6*3	19679	54*3	22222	12*4		
17146	42*3	19726	20*4	22321	8*8*2		
17266	16*4	19762	8*8	22395	6*6		
17282	36*3	19919	45*3	22443	6*3		
17399	54*3	19947	4*4	22481	60*3		
17402	12*4*2	19981	12*4*2	22654	16*4		
17422	12*4	19982	28*4	22711	42*3		
17427	4*4	20002	12*4	22717	10*5		
17561	12*12	20091	8*4	22763	8*4		
17574	12*4*2	20129	60*3	22862	12*4*2		
17723	18*3	20155	4*4	22873	12*4		
17751	28*4	20162	36*4	22965	12*6*2		
17753	24*4	20310	12*4*2	23095	16*4		
18021	10*10	20366	44*4	23137	16*4		
18046	24*4	20398	8*4*2	23142	4*4*2*2		
18158	40*4	20445	8*4*2*2	23155	8*4		
18278	12*4*2	20654	44*4	23165	12*6*2		
18285	4*4*2*2	20658	8*4*2	23178	12*6		
18286	16*4	20734	24*4	23190	16*4*2		
18362	30*3	20737	16*4	23329	24*4		
18409	28*4	21018	6*6*2	23377	16*4		