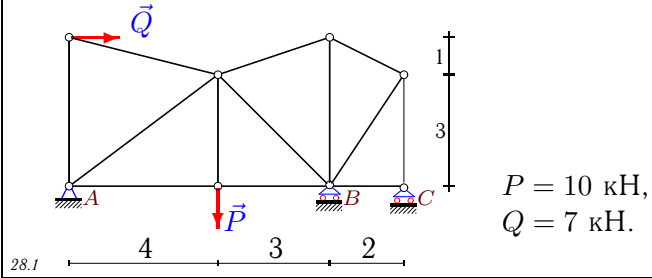
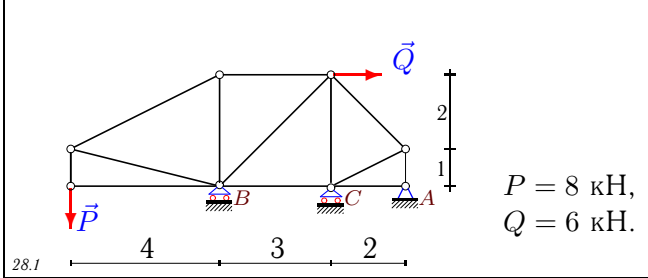


# Расчет статически неопределимой фермы

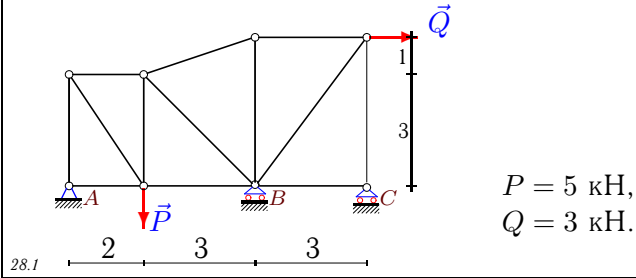
**Задача 28.1**



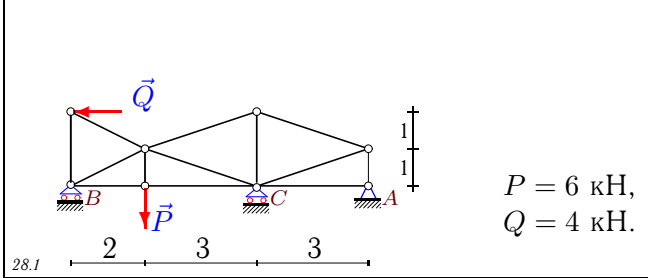
**Задача 28.2**



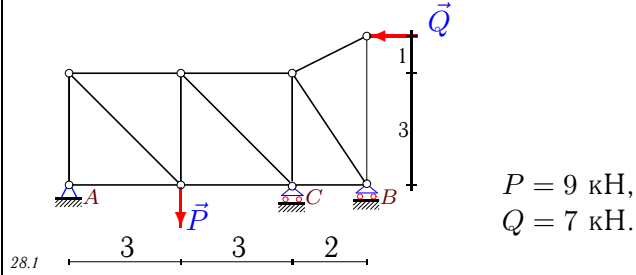
**Задача 28.3**



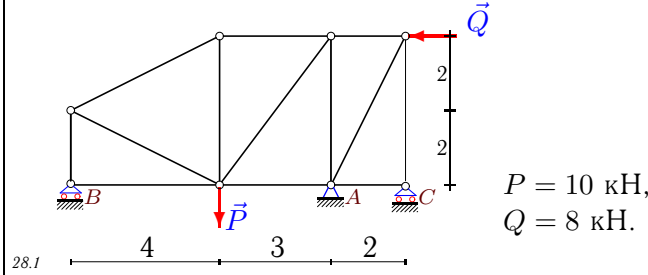
**Задача 28.4**



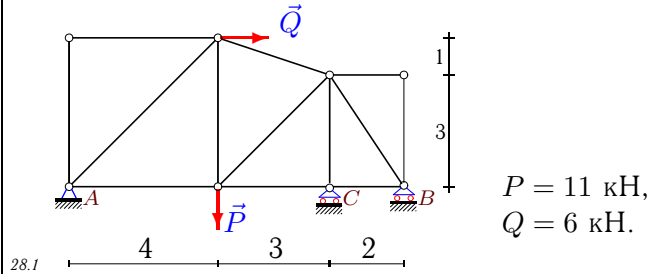
**Задача 28.5**



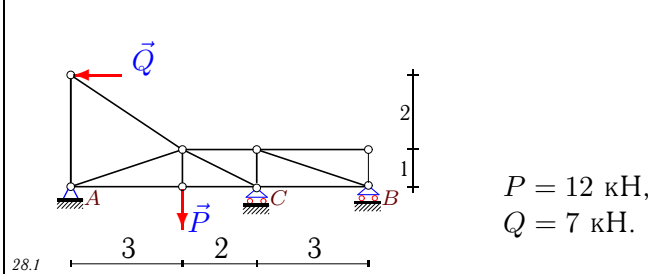
**Задача 28.6**



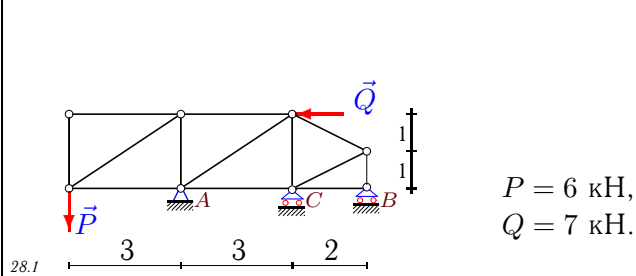
**Задача 28.7**



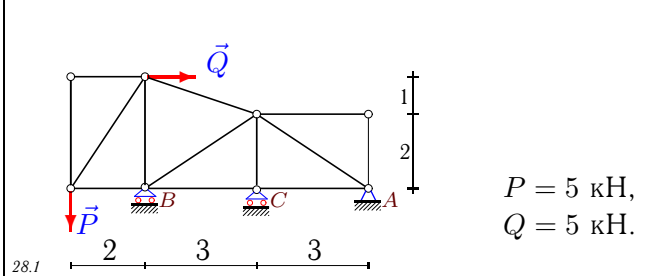
**Задача 28.8**



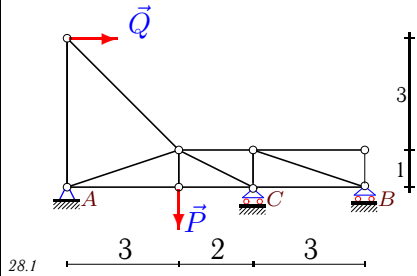
**Задача 28.9**



**Задача 28.10**



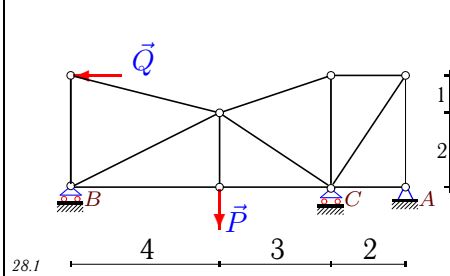
Задача 28.11



$P = 11 \text{ кН},$   
 $Q = 4 \text{ кН}.$

28.1

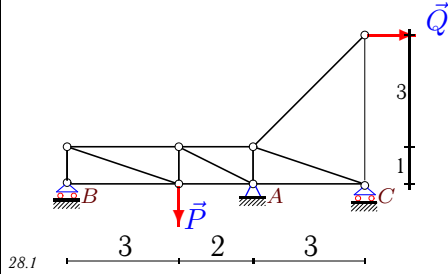
Задача 28.12



$P = 7 \text{ кН},$   
 $Q = 3 \text{ кН}.$

28.1

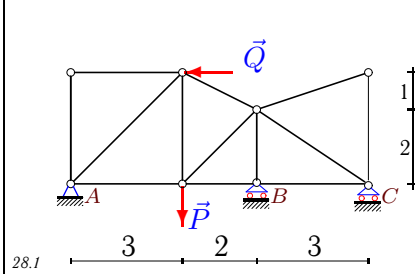
Задача 28.13



$P = 5 \text{ кН},$   
 $Q = 4 \text{ кН}.$

28.1

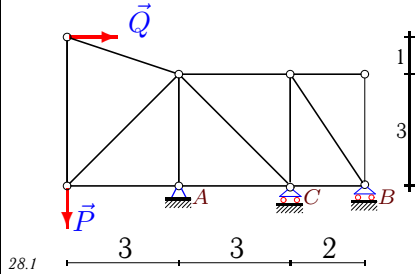
Задача 28.14



$P = 6 \text{ кН},$   
 $Q = 9 \text{ кН}.$

28.1

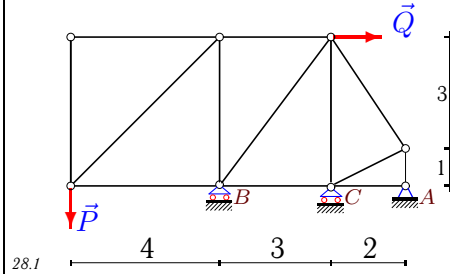
Задача 28.15



$P = 12 \text{ кН},$   
 $Q = 8 \text{ кН}.$

28.1

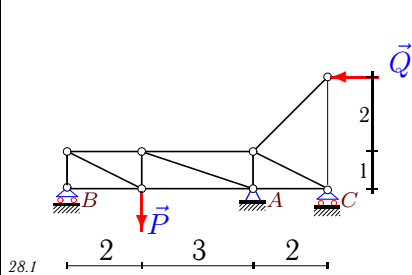
Задача 28.16



$P = 13 \text{ кН},$   
 $Q = 7 \text{ кН}.$

28.1

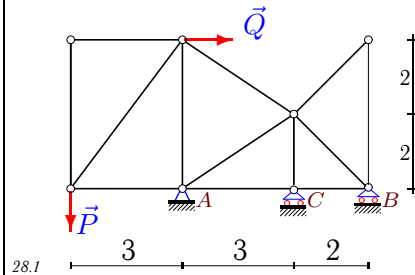
Задача 28.17



$P = 10 \text{ кН},$   
 $Q = 4 \text{ кН}.$

28.1

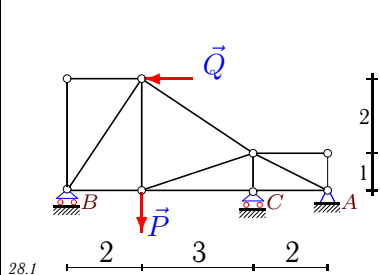
Задача 28.18



$P = 10 \text{ кН},$   
 $Q = 5 \text{ кН}.$

28.1

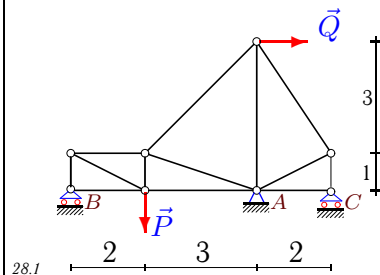
Задача 28.19



$P = 6 \text{ кН},$   
 $Q = 6 \text{ кН}.$

28.1

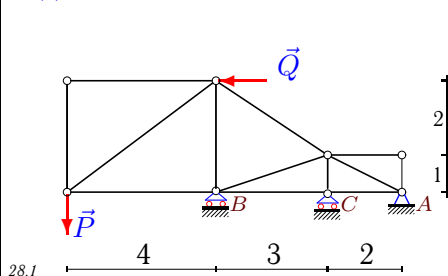
Задача 28.20



$P = 10 \text{ кН},$   
 $Q = 3 \text{ кН}.$

28.1

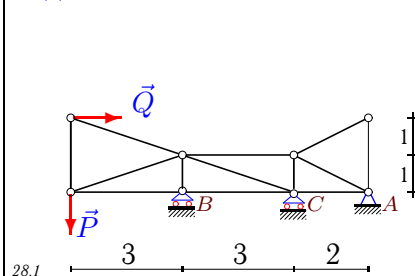
Задача 28.21



$P = 7 \text{ кН},$   
 $Q = 7 \text{ кН}.$

28.1

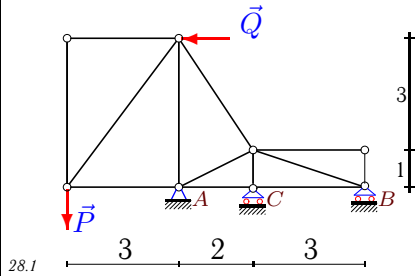
Задача 28.22



$P = 11 \text{ кН},$   
 $Q = 8 \text{ кН}.$

28.1

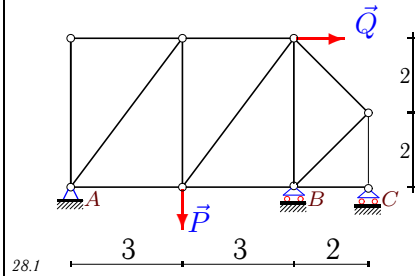
Задача 28.23



$P = 9 \text{ кН},$   
 $Q = 5 \text{ кН}.$

28.1

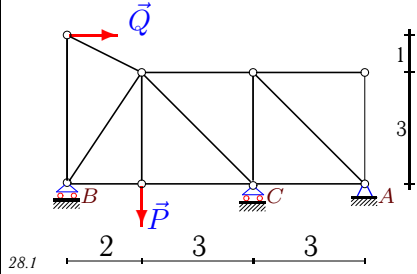
Задача 28.24



$P = 7 \text{ кН},$   
 $Q = 4 \text{ кН}.$

28.1

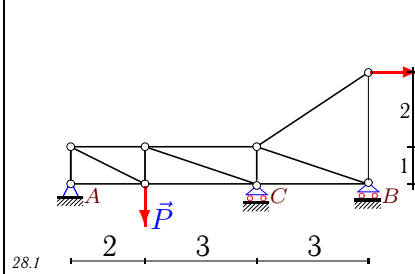
Задача 28.25



$P = 6 \text{ кН},$   
 $Q = 9 \text{ кН}.$

28.1

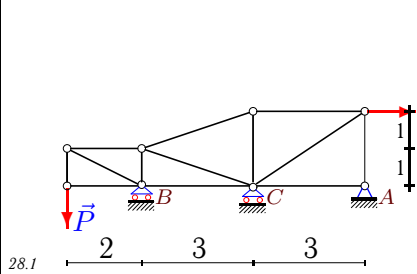
Задача 28.26



$P = 8 \text{ кН},$   
 $Q = 7 \text{ кН}.$

28.1

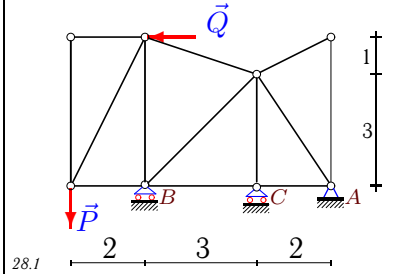
Задача 28.27



$P = 8 \text{ кН},$   
 $Q = 4 \text{ кН}.$

28.1

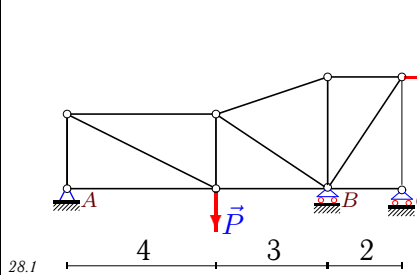
Задача 28.28



$P = 10 \text{ кН},$   
 $Q = 9 \text{ кН}.$

28.1

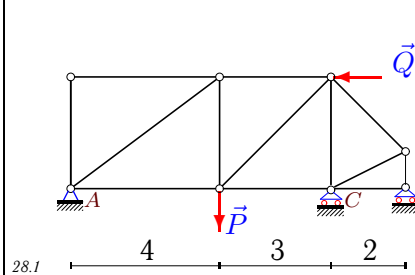
Задача 28.29



$P = 9 \text{ кН},$   
 $Q = 3 \text{ кН}.$

28.1

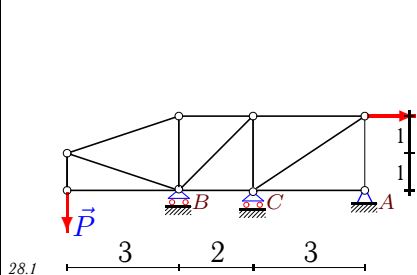
Задача 28.30



$P = 12 \text{ кН},$   
 $Q = 9 \text{ кН}.$

28.1

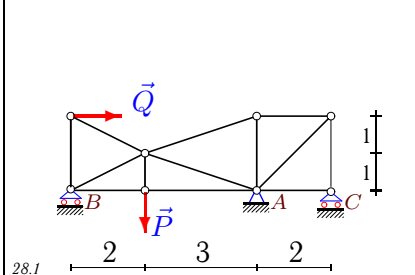
Задача 28.31



$P = 8 \text{ кН},$   
 $Q = 8 \text{ кН}.$

28.1

Задача 28.32



$P = 8 \text{ кН},$   
 $Q = 8 \text{ кН}.$

28.1

### Расчет статически неопределимой фермы

	$\delta_{11}$	$\Delta_{1P}$	$X_A$	$Y_A$	$Y_B$	$Y_C$
1	10.471	24.170	-7.000	-0.374	12.682	-2.308
2	5.470	5.687	-6.000	-2.176	11.216	-1.040
3	21.601	-26.318	-3.000	1.331	2.451	1.218
4	14.945	-47.791	4.000	-1.499	4.301	3.198
5	7.678	-64.024	7.000	7.040	-6.379	8.339
6	13.207	59.620	8.000	6.947	7.567	-4.514
7	9.521	-64.826	-6.000	1.931	2.260	6.809
8	42.669	-200.565	7.000	8.362	-1.063	4.701
9	6.307	2.348	7.000	12.549	-6.177	-0.372
10	11.234	13.620	-5.000	1.440	4.773	-1.212
11	42.669	-548.980	-4.000	0.050	-1.916	12.866
12	9.053	-62.571	3.000	-3.265	3.353	6.912
13	109.952	-431.690	-4.000	-0.082	1.156	3.926
14	40.241	66.848	9.000	6.803	0.858	-1.661
15	5.593	-13.069	-8.000	11.865	-2.202	2.337
16	6.076	2.709	-7.000	-4.532	17.978	-0.446
17	42.549	235.969	4.000	9.364	6.182	-5.546
18	7.711	11.226	-5.000	12.582	-1.127	-1.456
19	23.492	-40.363	6.000	-2.084	6.366	1.718
20	18.625	26.804	-3.000	8.415	3.024	-1.439
21	17.285	155.114	7.000	-4.416	20.390	-8.974
22	16.805	36.081	-8.000	-2.112	15.259	-2.147
23	17.285	343.277	5.000	30.316	-1.456	-19.860
24	10.912	-29.396	-4.000	1.731	2.575	2.694
25	9.068	-42.141	-9.000	3.096	-1.743	4.647
26	42.950	38.816	-7.000	3.714	5.190	-0.904
27	9.445	12.438	-4.000	-0.675	9.992	-1.317
28	7.033	9.756	9.000	-10.368	21.755	-1.387
29	15.292	24.206	-3.000	2.119	8.464	-1.583
30	7.198	-57.269	9.000	7.899	-3.855	7.957
31	6.751	32.629	-8.000	0.333	12.500	-4.833
32	18.522	56.352	-8.000	10.659	0.383	-3.042

В первой строке — усилия от действия основной нагрузки, во второй — от единичной силы в опоре  $C$ .

	$U_1$	$U_2$	$U_3$	$V_1$	$V_2$	$V_3$	$V_4$	$O_1$	$O_2$	$O_3$	$D_1$	$D_2$	$D_3$	$X_A$	$Y_A$	$Y_B$
1	9.71	9.71	0.00	1.75	10.00	0.00	0.00	-7.22	-0.00	-0.00	-3.39	-13.74	0.00	-7.00	0.29	9.71
	0.38	0.38	0.00	-0.00	0.00	0.42	-1.00	0.00	-0.53	-0.56	-0.48	0.17	0.90	0.00	0.29	-1.29
2	0.00	-7.87	-6.00	8.00	-5.33	0.93	2.80	11.93	10.67	2.64	-10.99	-3.96	-2.09	-6.00	-2.80	10.80
	0.00	-0.40	-0.00	0.00	0.00	-0.80	0.60	-0.00	-0.00	0.57	0.00	0.57	-0.45	0.00	-0.60	-0.40
3	3.00	3.40	-0.00	-0.60	4.40	-1.00	0.00	-0.40	3.16	3.00	0.72	-4.81	0.00	-3.00	0.60	4.40
	-0.00	0.40	-0.00	-0.60	-0.60	0.25	-1.00	-0.40	-0.79	-0.75	0.72	0.49	1.25	0.00	0.60	-1.60
4	7.00	7.00	4.00	-2.00	6.00	0.50	-0.50	4.47	-0.79	-0.79	-7.83	-2.37	0.79	4.00	0.50	5.50
	-0.75	-0.75	0.00	0.00	0.00	-0.63	0.63	0.00	0.99	0.99	0.84	-0.20	-0.99	0.00	-0.63	-0.38
5	-7.00	2.13	2.25	-9.13	-0.13	-0.13	3.50	-9.13	-9.25	-7.83	12.90	0.18	-4.06	7.00	9.13	-0.13
	0.00	-0.25	-0.50	0.25	0.25	-0.75	0.00	0.25	0.50	0.00	-0.35	-0.35	0.90	0.00	-0.25	-0.75
6	0.00	8.00	0.00	-8.86	4.43	-1.14	0.00	-9.90	-8.86	-8.00	9.90	1.43	0.00	8.00	1.14	8.86
	0.00	0.50	-0.00	-0.29	0.14	0.29	-1.00	-0.32	-0.29	-0.50	0.32	-0.36	1.12	0.00	-1.29	0.29
7	9.44	5.04	5.04	-0.00	6.59	0.00	0.00	0.00	-9.96	0.00	-4.87	6.23	-9.08	-6.00	3.44	7.56
	-0.22	-0.52	-0.52	0.00	-0.30	-1.00	0.00	0.00	0.23	-0.00	0.31	0.42	0.93	0.00	-0.22	-0.78
8	9.38	9.38	5.63	-4.67	12.00	1.88	-0.00	8.41	-5.63	-0.00	-17.26	-4.19	-5.93	7.00	10.13	1.88
	-1.13	-1.13	-1.88	0.00	0.00	-0.63	0.00	0.00	1.88	0.00	1.19	-0.84	1.98	0.00	-0.38	-0.63
9	-9.00	-6.40	0.00	0.00	-6.00	3.20	6.40	0.00	9.00	7.16	10.82	-11.54	-7.16	7.00	12.40	-6.40
	0.00	-0.60	-0.00	0.00	0.00	-0.70	0.60	0.00	-0.00	0.67	-0.00	0.72	-0.67	0.00	-0.40	-0.60
10	-3.33	-3.75	-3.75	0.00	-4.44	0.00	-0.00	0.00	-1.76	0.00	6.01	0.50	-1.50	-5.00	0.83	4.17
	0.00	-0.75	-0.75	0.00	0.00	-1.00	0.00	0.00	-0.00	-0.00	-0.00	0.90	0.90	0.00	-0.50	-0.50
11	30.63	30.63	18.38	4.00	11.00	6.13	-0.00	-5.66	-18.38	-0.00	-28.07	-13.70	-19.37	-4.00	4.87	6.13
	-1.13	-1.13	-1.88	0.00	0.00	-0.63	0.00	0.00	1.88	0.00	1.19	-0.84	1.98	0.00	-0.38	-0.63
12	8.28	8.28	3.00	-0.75	7.00	0.47	-2.11	3.09	-1.48	-1.41	-9.25	-4.65	2.54	3.00	2.11	4.89
	-0.44	-0.44	-0.00	-0.00	0.00	-0.17	0.78	0.00	0.55	0.52	0.50	-0.09	-0.93	0.00	-0.78	-0.22
13	0.00	-3.60	-12.00	1.20	6.20	0.00	-4.00	3.60	16.00	5.66	-3.79	-13.86	12.65	-4.00	6.20	-1.20
	0.00	1.80	3.00	-0.60	-0.60	1.00	0.00	-1.80	-3.00	-0.00	1.90	1.34	-3.16	0.00	-1.60	0.60
14	-1.20	0.00	0.00	0.00	7.20	1.80	-0.00	0.00	1.34	-0.00	-11.03	-1.70	0.00	9.00	7.80	-1.80
	0.60	1.50	1.50	0.00	0.90	1.60	-0.00	0.00	-0.67	0.00	-0.85	-1.27	-1.80	0.00	0.60	-1.60
15	-9.33	-1.33	-0.53	2.67	-12.80	-0.80	0.00	-8.43	0.53	0.00	13.20	1.13	0.96	-8.00	12.80	-0.80
	0.00	0.00	-0.40	0.00	0.40	-0.60	0.00	0.00	0.40	-0.00	-0.00	-0.57	0.72	0.00	-0.40	-0.60
16	-13.00	-9.40	-7.00	0.00	-13.00	1.20	4.80	0.00	13.00	4.33	18.38	-6.00	-2.68	-7.00	-4.80	17.80
	0.00	-0.30	-0.00	0.00	0.00	-0.85	0.60	0.00	-0.00	0.54	-0.00	0.50	-0.34	0.00	-0.60	-0.40
17	0.00	16.80	8.00	-8.40	1.60	-0.00	4.00	-16.80	-12.00	-5.66	18.78	-5.06	-8.94	4.00	1.60	8.40
	0.00	0.80	2.00	-0.40	-0.40	1.00	0.00	-0.80	-2.00	-0.00	0.89	1.26	-2.24	0.00	-1.40	0.40
18	-7.50	-2.00	-2.00	-0.00	-11.67	0.00	-0.00	0.00	3.00	0.00	12.50	-0.60	2.83	-5.00	12.00	-2.00
	0.00	-0.60	-0.60	0.00	0.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.72	0.85	0.00	-0.40	-0.60
19	4.57	4.29	4.29	-0.00	5.90	0.00	-0.00	0.00	1.72	0.00	-8.24	0.30	1.92	6.00	-0.86	6.86
	-0.19	-1.43	-1.43	0.00	-0.41	-1.00	0.00	0.00	0.23	0.00	0.34	1.31	1.60	0.00	-0.71	-0.29
20	0.00	7.20	0.00	-3.60	6.40	-3.00	0.00	-7.20	4.24	0.00	8.05	-10.75	-0.00	-3.00	6.40	3.60
	0.00	0.80	0.00	-0.40	-0.40	1.25	-1.00	-0.80	-0.71	-0.90	0.89	-0.32	0.56	-0.00	-1.40	0.40
21	-9.33	-12.60	-12.60	-0.00	-17.89	0.00	0.00	0.00	19.63	0.00	11.67	3.44	21.91	7.00	-9.80	16.80
	-0.00	-1.20	-1.20	-0.00	-0.00	-1.00	0.00	0.00	0.00	0.00	0.00	1.26	1.34	0.00	-0.60	-0.40
22	-25.00	-25.00	-14.80	2.67	-14.40	-3.40	0.00	-8.43	6.80	0.00	26.35	10.75	7.60	-8.00	-3.40	14.40
	0.00	0.00	-1.20	0.00	0.40	-0.60	0.00	0.00	1.20	0.00	-0.00	-1.26	1.34	0.00	-0.60	-0.40
23	-6.75	-28.20	-28.20	0.00	-26.63	0.00	0.00	0.00	21.18	-0.00	11.25	18.39	29.73	5.00	18.40	-9.40
	0.00	-1.20	-1.20	0.00	0.00	-1.00	0.00	0.00	-0.00	-0.00	-0.00	1.34	1.26	0.00	-0.60	-0.40
24	4.63	0.00	0.00	0.00	0.83	-6.17	0.00	0.00	-0.63	-0.00	-1.04	7.71	0.00	-4.00	0.83	6.17
	0.25	0.50	-0.00	0.00	0.33	0.83	-1.00	0.00	-0.25	-0.71	-0.42	-0.42	0.71	0.00	0.33	-1.33
25	3.00	3.00	-3.00	4.50	6.00	6.00	0.00	-10.06	-6.00	0.00	-5.41	-8.49	-8.49	-9.00	6.00	-0.00
	-0.25	-0.25	-0.63	0.00	0.00	-0.63	0.00	0.00	0.63	0.00	0.45	-0.53	0.88	0.00	-0.63	-0.38
26	7.00	13.75	-0.13	-3.37	4.63	4.63	-4.67	-6.75	7.13	8.41	7.55	-14.63	0.13	-7.00	3.37	4.62
	0.00	-0.75	-1.88	0.38	0.38	-0.63	-0.00	0.75	1.88	0.00	-0.84	-1.19	1.98	0.00	-0.38	-0.63
27	0.00	-16.00	-4.00	8.00	-1.33	-2.00	1.33	16.00	6.32	6.00	-17.89	10.54	-2.40	-4.00	-1.33	9.33
	0.00	0.00	0.00	0.00	0.50	-0.25	0.50	-0.00	0.79	0.75	0.00	-0.79	-0.90	0.00	-0.50	-0.50
28	-5.00	1.53	1.53	0.00	-14.67	0.00	0.00	0.00	14.76	-0.00	11.18	-9.24	13.46	9.00	-11.20	21.20
	-0.00	-0.40	-0.40	-0.00	-0.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.57	0.72	0.00	-0.60	-0.40
29	3.00	8.14	0.00	-2.57	6.43	-1.00	0.00	-5.14	3.16	3.00	5.75	-9.79	0.00	-3.00	2.57	6.43
	0.00	0.57	-0.00	-0.29	-0.29	0.22	-1.00	-0.57	-0.70	-0.67	0.64	0.11	1.20	0.00	0.29	-1.29
30	3.89	1.56	-0.00	-0.00	9.67	-0.78	-2.33	0.00	-12.89	-2.20	-16.11	3.30	1.74	9.00	9.67	2.33
	-0.30	-0.52	0.00	-0.00	-0.22	-0.74	0.78	0.00	0.30	0.73	0.37	0.31	-0.58	0.00	-0.22	-0.78
31	0.00	-10.40	-8.00	8.00	-4.00	1.60	1.60	12.65	12.00	10.40	-12.65	-2.26	-2.88	-8.00	-1.60	9.60
	0.00	-0.60	-0.00	0.00	0.00	-0.60	0.40	0.00	0.00	0.60	-0.00	0.85	-0.72	0.00	-0.40	-0.60
32	11.20	11.20	0.00	4.00	8.00	0.00	0.00	-8.94	0.00	0.00	-12.52	-20.24	0.00	-8.00	6.40	1.60
	0.80	0.80	-0.00	0.00	0.00	0.33	-1.00	0.00	-1.05	-1.00	-0.89	0.21	1.41	0.00	-1.40	0.40