

## Расчет статически неопределимой фермы (2)

Найти реакции опор фермы и усилие  $S$  в дополнительном раскосе, выделенном утолщенной линией.

**Задача M24.1.** 5

$P = 9 \text{ кН},$   
 $Q = 3 \text{ кН},$   
 $\beta = 30^\circ.$

**Задача M24.2.** 5

$P = 11 \text{ кН},$   
 $Q = 6 \text{ кН},$   
 $\beta = 45^\circ.$

**Задача M24.3.** 5

$P = 10 \text{ кН},$   
 $Q = 8 \text{ кН},$   
 $\beta = 30^\circ.$

**Задача M24.4.** 5

$P = 6 \text{ кН},$   
 $Q = 4 \text{ кН},$   
 $\beta = 15^\circ.$

**Задача M24.5.** 5

$P = 11 \text{ кН},$   
 $Q = 9 \text{ кН},$   
 $\beta = 30^\circ.$

**Задача M24.6.** 5

$P = 6 \text{ кН},$   
 $Q = 8 \text{ кН},$   
 $\beta = 30^\circ.$

**Задача M24.7.** 5

$P = 6 \text{ кН},$   
 $Q = 5 \text{ кН},$   
 $\beta = 15^\circ.$

**Задача M24.8.** 5

$P = 8 \text{ кН},$   
 $Q = 8 \text{ кН},$   
 $\beta = 45^\circ.$

**Задача M24.9.** 5

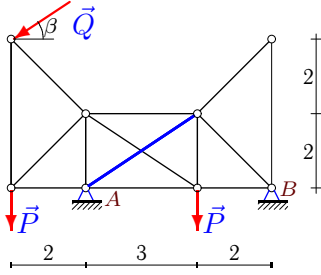
$P = 7 \text{ кН},$   
 $Q = 3 \text{ кН},$   
 $\beta = 30^\circ.$

**Задача M24.10.** 5

$P = 10 \text{ кН},$   
 $Q = 9 \text{ кН},$   
 $\beta = 45^\circ.$

**Задача M24.11.**

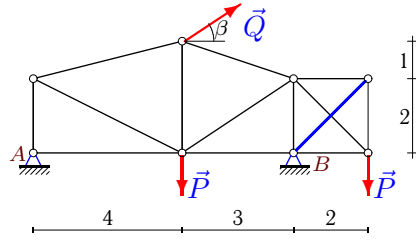
5



$P = 8 \text{ кН},$   
 $Q = 7 \text{ кН},$   
 $\beta = 30^\circ.$

**Задача M24.12.**

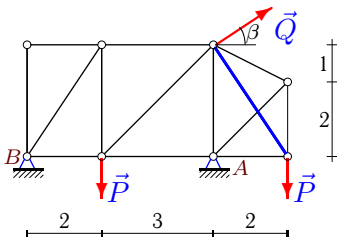
5



$P = 13 \text{ кН},$   
 $Q = 5 \text{ кН},$   
 $\beta = 15^\circ.$

**Задача M24.13.**

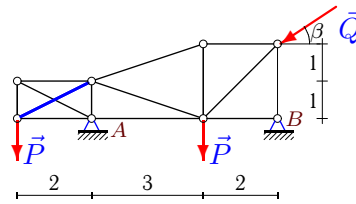
5



$P = 13 \text{ кН},$   
 $Q = 5 \text{ кН},$   
 $\beta = 15^\circ.$

**Задача M24.14.**

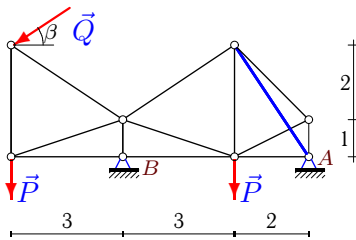
5



$P = 7 \text{ кН},$   
 $Q = 7 \text{ кН},$   
 $\beta = 45^\circ.$

**Задача M24.15.**

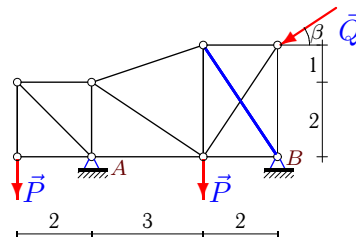
5



$P = 10 \text{ кН},$   
 $Q = 6 \text{ кН},$   
 $\beta = 15^\circ.$

**Задача M24.16.**

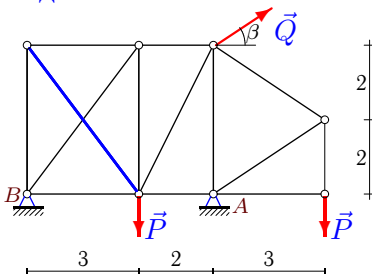
5



$P = 9 \text{ кН},$   
 $Q = 6 \text{ кН},$   
 $\beta = 45^\circ.$

**Задача M24.17.**

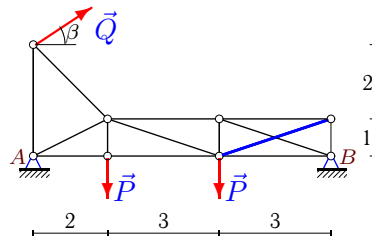
5



$P = 12 \text{ кН},$   
 $Q = 7 \text{ кН},$   
 $\beta = 30^\circ.$

**Задача M24.18.**

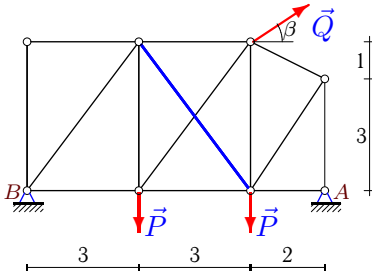
5



$P = 13 \text{ кН},$   
 $Q = 8 \text{ кН},$   
 $\beta = 15^\circ.$

**Задача M24.19.**

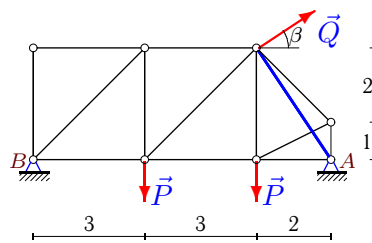
5



$P = 7 \text{ кН},$   
 $Q = 6 \text{ кН},$   
 $\beta = 30^\circ.$

**Задача M24.20.**

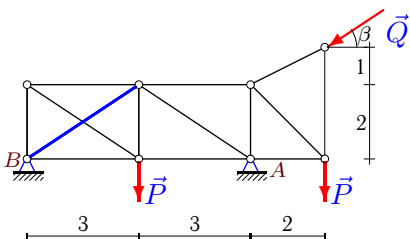
5



$P = 13 \text{ кН},$   
 $Q = 9 \text{ кН},$   
 $\beta = 30^\circ.$

**Задача M24.21.**

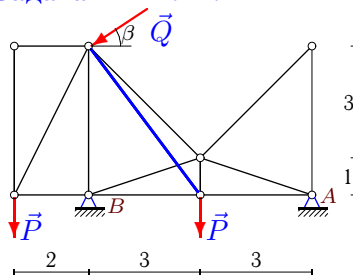
5



$P = 11 \text{ кН},$   
 $Q = 3 \text{ кН},$   
 $\beta = 45^\circ.$

**Задача M24.22.**

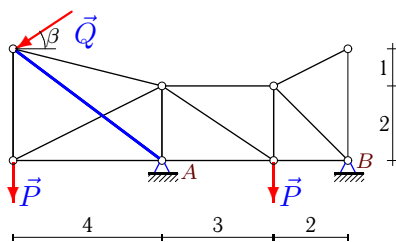
5



$P = 7 \text{ кН},$   
 $Q = 8 \text{ кН},$   
 $\beta = 45^\circ.$

**Задача M24.23.**

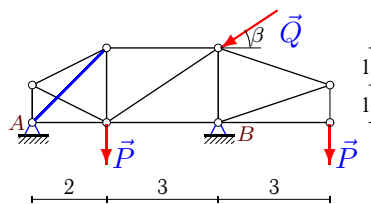
5



$P = 10 \text{ кН},$   
 $Q = 3 \text{ кН},$   
 $\beta = 15^\circ.$

**Задача M24.24.**

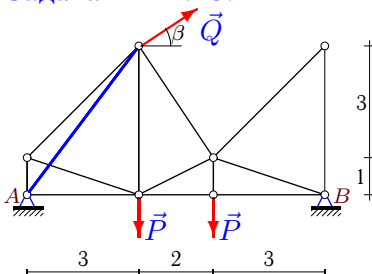
5



$P = 7 \text{ кН},$   
 $Q = 4 \text{ кН},$   
 $\beta = 45^\circ.$

**Задача M24.25.**

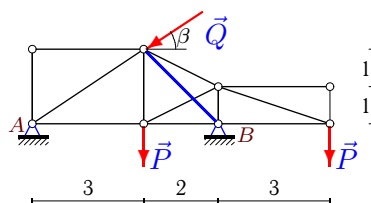
5



$P = 5 \text{ кН},$   
 $Q = 7 \text{ кН},$   
 $\beta = 15^\circ.$

**Задача M24.26.**

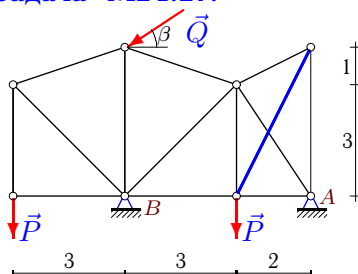
5



$P = 11 \text{ кН},$   
 $Q = 5 \text{ кН},$   
 $\beta = 45^\circ.$

**Задача M24.27.**

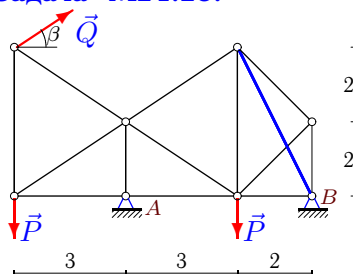
5



$P = 13 \text{ кН},$   
 $Q = 6 \text{ кН},$   
 $\beta = 30^\circ.$

**Задача M24.28.**

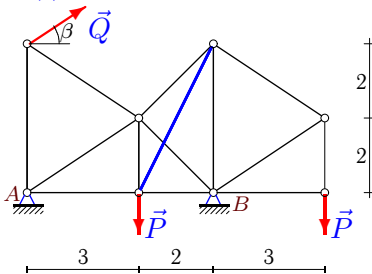
5



$P = 12 \text{ кН},$   
 $Q = 4 \text{ кН},$   
 $\beta = 15^\circ.$

**Задача M24.29.**

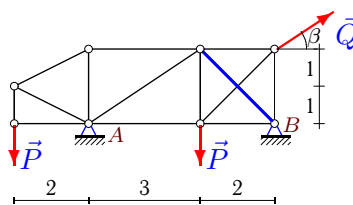
5



$P = 12 \text{ кН},$   
 $Q = 5 \text{ кН},$   
 $\beta = 15^\circ.$

**Задача M24.30.**

5



$P = 10 \text{ кН},$   
 $Q = 5 \text{ кН},$   
 $\beta = 45^\circ.$

**М24 Ответы.****Расчет статически неопределимой фермы (2)**

16.06.2012

	$\delta_{11}$	$\delta_{12}$	$\delta_{22}$	$\Delta_{1p}$	$\Delta_{2p}$	$X_B$	$S$	$X_A$	$Y_A$	$Y_B$
1	8.000	1.800	13.760	-37.206	-44.513	4.042	2.706	-6.640	8.799	7.701
2	5.000	2.496	11.009	24.515	-4.551	-5.761	1.720	10.004	26.746	-0.503
3	9.000	3.578	16.144	-31.081	80.067	5.949	-6.278	-12.877	11.301	4.699
4	5.000	0.894	11.975	15.015	-37.069	-3.605	3.365	-0.259	16.291	-5.326
5	5.000	2.496	12.596	-7.794	-157.108	-5.181	13.500	-2.614	28.235	-10.735
6	9.000	1.109	7.745	-44.729	-39.145	4.425	4.421	-11.353	7.865	0.135
7	5.000	0.000	7.374	-16.830	44.930	3.366	-6.093	-8.196	12.732	-2.026
8	7.000	0.000	7.374	33.917	-35.232	-4.845	4.778	-0.812	-0.473	10.817
9	6.000	-1.800	11.750	-16.165	64.635	1.094	-5.333	-3.692	-1.315	13.815
10	9.000	-3.578	14.981	267.275	-244.372	-25.648	10.187	19.284	-0.000	13.636
11	5.000	-2.496	12.596	-80.173	161.537	10.690	-10.706	-4.627	24.150	-4.650
12	7.000	0.000	9.657	-19.681	106.409	2.812	-11.019	-7.641	-0.767	25.473
13	5.000	0.000	9.129	40.886	-35.079	-8.177	3.842	3.348	25.004	-0.298
14	5.000	0.000	8.072	-56.849	-59.785	11.370	7.406	-6.420	14.580	4.370
15	5.000	1.109	7.745	127.158	-19.803	-26.853	6.404	32.648	-4.409	25.962
16	5.000	-1.109	12.596	-39.728	6.537	7.987	0.184	-3.744	18.746	3.497
17	5.000	1.800	17.280	46.436	78.297	-7.954	-3.703	1.892	27.750	-7.250
18	8.000	-2.846	11.925	361.638	-269.104	-40.626	12.871	32.898	9.657	14.273
19	8.000	1.800	17.280	7.398	20.545	-0.673	-1.119	-4.523	8.223	2.777
20	8.000	1.109	7.745	-11.356	57.851	2.505	-7.829	-10.299	14.173	7.327
21	6.000	2.496	12.596	-9.841	15.052	2.329	-1.657	-0.208	21.934	2.187
22	6.000	1.800	11.200	12.941	-33.717	-3.215	3.527	8.872	-2.605	22.261
23	5.000	-0.000	15.141	-86.418	198.282	17.284	-13.095	-14.386	25.136	-4.360
24	5.000	-1.414	7.374	-37.157	8.872	7.498	0.235	-4.669	1.131	15.697
25	8.000	-1.800	11.200	135.805	-19.446	-17.207	-1.029	10.446	0.487	7.701
26	5.000	-1.414	7.374	-73.779	122.226	10.645	-14.535	-7.109	0.628	24.907
27	5.000	0.894	11.975	-12.124	-22.529	2.117	1.723	3.080	-4.157	33.157
28	5.000	-0.894	9.535	-26.159	10.498	5.121	-0.621	-8.984	19.253	3.712
29	5.000	-0.894	9.535	1.319	-41.073	0.516	4.356	-5.345	-7.558	30.264
30	5.000	-1.414	9.657	10.243	4.000	-2.259	-0.745	-1.276	16.586	-0.121

М24 файл о24т5В

В первой строке — усилия от действия основной нагрузки, во второй — от единичной горизонтальной силы в опоре В, в третьей — от единичных сил в дополнительном раскосе.

	$U_1$	$U_2$	$U_3$	$V_1$	$V_2$	$V_3$	$V_4$	$O_1$	$O_2$	$O_3$	$D_1$	$D_2$	$D_3$
1	0.000 -1.000 0.000	6.201 -1.000 -0.600	6.201 -1.000 0.000	-7.701 0.000 -0.000	5.575 0.000 -0.600	9.000 0.000 -0.800	0.000 0.000 -0.000	-4.305 0.000 0.000	-6.797 0.000 -0.632	0.000 0.000 0.000	6.942 0.000 0.000	-3.324 0.000 0.849	-12.444 0.000 -0.000
2	0.000 -1.000 -0.832	-12.257 -1.000 0.000	-0.000 0.000 0.000	0.503 0.000 -0.555	-0.251 0.000 -0.277	-21.246 0.000 0.000	11.000 0.000 0.000	0.795 0.000 -0.877	0.754 0.000 0.000	17.393 0.000 0.000	-0.795 0.000 0.877	16.268 0.000 -0.000	-17.393 0.000 0.000
3	0.000 -1.000 -0.894	9.397 -1.000 0.000	1.445 -1.000 0.000	-4.699 0.000 -0.447	5.301 0.000 -0.447	15.301 0.000 0.000	-2.928 0.000 0.000	-9.397 0.000 -0.894	-1.445 0.000 0.000	9.798 0.000 0.000	10.506 0.000 1.000	-9.557 0.000 0.000	-11.842 0.000 0.000
4	-3.003 -1.000 0.000	-3.003 -1.000 -0.447	0.000 0.000 0.000	2.323 0.000 0.000	6.000 0.000 -0.894	-3.750 0.000 -0.671	6.000 0.000 0.000	-4.073 0.000 0.000	5.031 0.000 -0.500	4.743 0.000 0.000	4.247 0.000 -0.000	-9.664 0.000 0.806	-6.364 0.000 0.000
5	1.559 -1.000 0.000	1.559 -1.000 -0.832	-16.500 0.000 0.000	12.294 0.000 0.000	11.000 0.000 -0.555	-11.000 0.000 -0.555	0.000 0.000 0.000	-11.023 0.000 0.000	16.500 0.000 -0.832	0.000 0.000 0.000	-2.205 0.000 0.000	-31.072 0.000 1.000	19.831 0.000 0.000
6	0.180 -1.000 0.000	8.802 -1.000 -0.000	8.802 -1.000 -0.555	-0.000 0.000 0.000	8.874 0.000 -0.000	6.000 0.000 -0.832	0.000 0.000 -0.277	0.000 0.000 0.000	-8.543 0.000 0.000	-0.000 0.000 -0.784	-0.225 0.000 0.000	-9.088 0.000 0.000	-17.587 0.000 0.620
7	3.366 -1.000 0.000	3.366 -1.000 0.000	-12.000 0.000 -0.707	3.709 0.000 -0.000	6.000 0.000 0.000	-6.000 0.000 -0.707	0.000 0.000 -0.354	-5.400 0.000 0.000	12.000 0.000 0.000	0.000 0.000 -0.791	-3.763 0.000 0.000	-21.288 0.000 0.000	13.416 0.000 0.791
8	5.657 1.000 0.000	3.763 1.000 0.000	0.000 0.000 -0.707	0.473 0.000 -0.000	8.473 0.000 0.000	-2.895 0.000 -0.354	8.000 0.000 -0.707	1.894 0.000 0.000	14.396 0.000 0.000	8.944 0.000 -0.791	-1.952 0.000 0.000	-12.400 0.000 0.000	-8.944 0.000 0.791
9	1.612 1.000 0.000	-7.000 1.000 -0.600	-7.000 0.000 0.000	-0.000 0.000 0.000	1.259 0.000 -0.400	-13.815 0.000 -0.800	-0.000 0.000 0.000	0.000 0.000 0.000	-1.937 0.000 -0.721	0.000 0.000 0.000	1.644 0.000 0.000	10.350 0.000 0.721	9.899 0.000 0.000
10	38.182 1.000 -0.894	38.182 1.000 0.000	0.000 1.000 0.000	7.955 0.000 -0.224	10.000 0.000 -0.447	11.364 0.000 -0.000	-13.636 0.000 -0.000	-6.560 0.000 -0.922	-14.374 0.000 0.000	-15.246 0.000 0.000	-32.797 0.000 0.922	-25.873 0.000 -0.000	15.246 0.000 0.000
11	-17.562 0.000 0.000	-23.624 1.000 -0.832	-4.650 1.000 0.000	-9.562 0.000 0.000	-24.150 0.000 -0.555	-4.650 0.000 -0.555	0.000 0.000 0.000	8.573 0.000 0.000	4.650 0.000 -0.832	0.000 0.000 0.000	24.837 0.000 0.000	22.805 0.000 1.000	6.576 0.000 0.000
12	4.830 1.000 0.000	-13.000 1.000 0.000	-13.000 0.000 -0.707	0.767 0.000 -0.000	2.307 0.000 0.000	-25.473 0.000 -0.707	0.000 0.000 -0.707	1.055 0.000 0.000	-4.012 0.000 0.000	0.000 0.000 -0.707	-1.144 0.000 0.000	20.199 0.000 0.000	18.385 0.000 1.000
13	-0.199 -1.000 0.000	-13.496 -1.000 0.000	0.000 0.000 -0.555	-0.000 0.000 -0.000	-0.298 0.000 0.000	-16.337 0.000 -0.555	13.000 0.000 -0.832	0.000 0.000 0.000	0.199 0.000 0.000	9.690 0.000 -0.620	0.358 0.000 0.000	18.806 0.000 0.000	-12.257 0.000 0.784
14	0.000 0.000 -0.894	-18.950 1.000 0.000	0.000 1.000 0.000	7.000 0.000 -0.447	-7.580 0.000 -0.447	1.457 0.000 -0.000	-4.370 0.000 -0.000	14.000 0.000 -0.894	-4.606 0.000 0.000	-4.370 0.000 0.000	-15.652 0.000 1.000	19.364 0.000 0.000	-0.820 0.000 0.000
15	-46.250 0.000 0.000	-46.250 -1.000 0.000	5.796 -1.000 -0.555	-5.417 0.000 0.000	-25.962 0.000 -0.000	-4.899 0.000 -0.277	4.409 0.000 -0.832	6.965 0.000 0.000	3.533 0.000 -0.000	4.157 0.000 -0.784	48.752 0.000 0.000	51.762 0.000 0.000	-3.286 0.000 0.620
16	0.000 0.000 0.000	-13.243 1.000 0.000	0.000 1.000 -0.555	9.000 0.000 0.000	-9.746 0.000 0.000	1.249 0.000 -0.832	-3.497 0.000 -0.832	9.000 0.000 0.000	-3.948 0.000 0.000	-3.746 0.000 -0.555	-12.728 0.000 0.000	15.318 0.000 0.000	-0.896 0.000 1.000
17	-5.437 -1.000 -0.600	-15.062 -1.000 0.000	-0.000 0.000 0.000	0.000 0.000 -0.800	-7.250 0.000 -0.800	-21.750 0.000 0.000	12.000 0.000 0.000	0.000 0.000 -0.600	5.437 0.000 0.000	10.817 0.000 0.000	9.062 0.000 1.000	21.522 0.000 0.000	-10.817 0.000 0.000
18	46.637 1.000 0.000	46.637 1.000 0.000	42.818 1.000 -0.949	9.798 0.000 -0.000	13.000 0.000 0.000	14.273 0.000 -0.316	0.000 0.000 -0.316	-10.928 0.000 0.000	-42.818 0.000 0.000	0.000 0.000 -0.949	-43.502 0.000 0.000	-4.025 0.000 0.000	-45.134 0.000 1.000
19	2.083 -1.000 0.000	-1.085 -1.000 -0.600	-5.196 -1.000 0.000	-0.000 0.000 -0.000	2.777 0.000 -0.800	0.833 0.000 -0.800	-8.223 0.000 0.000	0.000 0.000 0.000	-2.083 0.000 -0.600	-4.597 0.000 0.000	-3.471 0.000 0.000	5.279 0.000 1.000	7.412 0.000 -0.000
20	7.327 -1.000 0.000	1.654 -1.000 0.000	-7.794 -1.000 -0.555	0.000 0.000 0.000	7.327 0.000 -0.277	8.276 0.000 -0.832	-14.173 0.000 -0.832	0.000 0.000 0.000	-7.327 0.000 0.000	-13.362 0.000 -0.784	-10.362 0.000 0.000	8.023 0.000 0.000	10.564 0.000 0.620
21	0.000 -1.000 -0.832	3.280 -1.000 0.000	-12.061 0.000 0.000	-2.187 0.000 -0.555	8.813 0.000 -0.555	-13.121 0.000 0.000	-1.061 0.000 0.000	-3.280 0.000 -0.832	9.939 0.000 0.000	-2.372 0.000 0.000	3.942 0.000 1.000	-15.888 0.000 -0.000	17.056 0.000 0.000
22	-3.500 0.000 0.000	-2.157 -1.000 -0.600	-2.157 -1.000 0.000	0.000 0.000 0.000	-21.814 0.000 -0.200	7.000 0.000 -0.800	-0.000 0.000 -0.000	0.000 0.000 0.000	12.950 0.000 -0.849	0.000 0.000 -0.000	7.826 0.000 -0.000	-1.416 0.000 0.632	8.236 0.000 -0.000
23	-23.002 0.000 -0.800	-25.900 1.000 -0.000	-4.360 1.000 0.000	-1.501 0.000 -0.400	-25.136 0.000 -0.600	-4.360 0.000 -0.000	0.000 0.000 0.000	2.987 0.000 -0.825	4.360 0.000 0.000	0.000 0.000 0.000	25.717 0.000 0.894	25.888 0.000 0.000	6.166 0.000 0.000
24	-2.828 1.000 -0.707	-10.500 1.000 0.000	-0.000 0.000 0.000	-1.131 0.000 -0.707	0.566 0.000 -0.354	-12.197 0.000 0.000	7.000 0.000 0.000	-1.265 0.000 -0.791	-1.131 0.000 0.000	11.068 0.000 0.000	1.265 0.000 0.791	10.580 0.000 0.000	-11.068 0.000 -0.000
25	6.761 1.000 -0.600	23.104 1.000 -0.000	23.104 1.000 -0.000	-0.487 0.000 -0.800	12.867 0.000 -0.200	5.000 0.000 0.000	-0.000 0.000 0.000	-0.516 0.000 -0.849	-12.848 0.000 0.000	0.000 0.000 -0.000	0.385 0.000 0.632	-17.863 0.000 0.000	-24.354 0.000 0.000
26	-2.593 1.000 0.000	-33.000 1.000 -0.707	-33.000 0.000 0.000	-0.000 0.000 -0.000	-4.204 0.000 -0.354	-24.907 0.000 -0.707	0.000 0.000 0.000	0.000 0.000 0.000	2.899 0.000 -0.791	-0.000 0.000 -0.000	-1.133 0.000 -0.000	33.996 0.000 0.791	34.785 0.000 0.000
27	0.000 0.000 0.000	2.425 -1.000 0.000	2.425 -1.000 -0.447	13.000 0.000 0.000	-11.232 0.000 0.000	13.000 0.000 -0.894	-0.000 0.000 -0.671	10.277 0.000 0.000	15.755 0.000 0.000	-0.000 0.000 -0.500	-13.789 0.000 0.000	-17.218 0.000 0.000	4.996 0.000 0.806
28	-12.583 0.000 -0.000	-8.720 1.000 -0.000	0.000 1.000 -0.447	3.611 0.000 -0.000	-19.253 0.000 0.000	3.093 0.000 -0.447	-3.712 0.000 -0.894	-4.644 0.000 0.000	-2.231 0.000 0.000	-2.625 0.000 -0.632	15.123 0.000 0.000	12.710 0.000 -0.000	2.625 0.000 0.632
29	0.264 1.000 0.000	0.264 1.000 -0.447	-0.000 0.000 -0.000	4.514 0.000 0.000	12.000 0.000 -0.894	-15.000 0.000 -0.447	12.000 0.000 0.000	-5.804 0.000 0.000	12.728 0.000 -0.632	10.817 0.000 0.000	5.488 0.000 0.000	-13.101 0.000 0.632	-10.817 0.000 0.000
30	0.000 0.000 0.000	3.414 1.000 0.000	-0.000 1.000 -0.707	10.000 0.000 0.000	-5.000 0.000 -0.000	6.586 0.000 -0.707	0.121 0.000 -0.707	11.180 0.000 0.000	10.000 0.000 0.000	0.121 0.000 -0.707	-11.180 0.000 0.000	-11.873 0.000 0.000	4.828 0.000 1.000