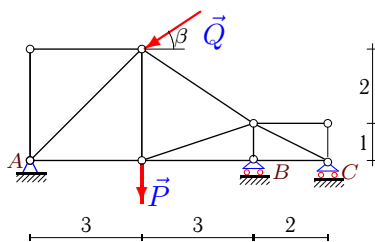


Расчет статически неопределимой фермы

Найти реакции опор фермы.

Задача M8.1.

5



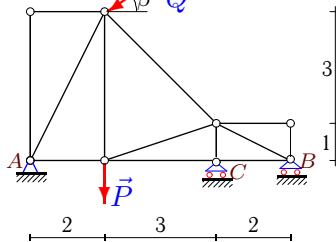
$$P = 11 \text{ кН},$$

$$Q = 4 \text{ кН},$$

$$\beta = 15^\circ.$$

Задача M8.2.

5



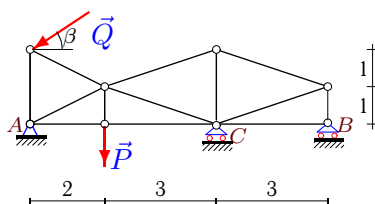
$$P = 9 \text{ кН},$$

$$Q = 6 \text{ кН},$$

$$\beta = 15^\circ.$$

Задача M8.3.

5



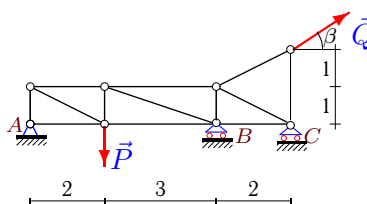
$$P = 6 \text{ кН},$$

$$Q = 9 \text{ кН},$$

$$\beta = 45^\circ.$$

Задача M8.4.

5



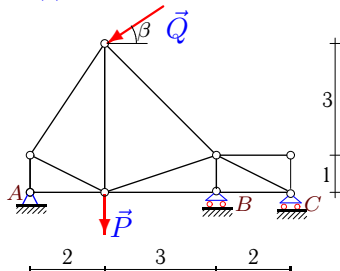
$$P = 6 \text{ кН},$$

$$Q = 9 \text{ кН},$$

$$\beta = 45^\circ.$$

Задача M8.5.

5



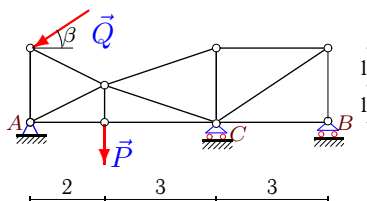
$$P = 9 \text{ кН},$$

$$Q = 6 \text{ кН},$$

$$\beta = 45^\circ.$$

Задача M8.6.

5



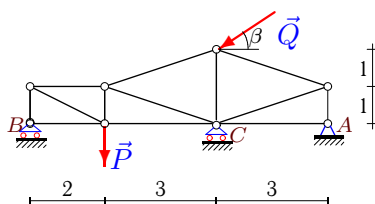
$$P = 13 \text{ кН},$$

$$Q = 9 \text{ кН},$$

$$\beta = 15^\circ.$$

Задача M8.7.

5



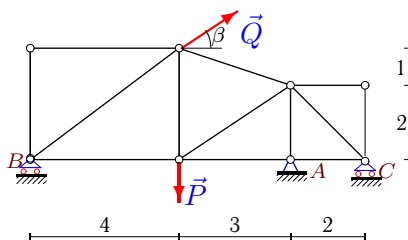
$$P = 7 \text{ кН},$$

$$Q = 9 \text{ кН},$$

$$\beta = 45^\circ.$$

Задача M8.8.

5



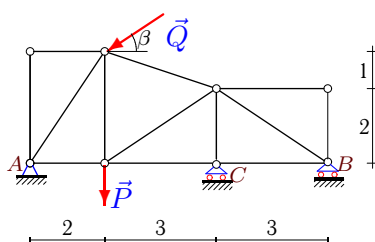
$$P = 8 \text{ кН},$$

$$Q = 9 \text{ кН},$$

$$\beta = 15^\circ.$$

Задача M8.9.

5



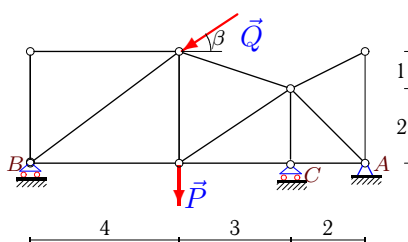
$$P = 5 \text{ кН},$$

$$Q = 4 \text{ кН},$$

$$\beta = 15^\circ.$$

Задача M8.10.

5



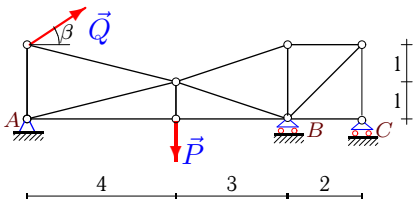
$$P = 11 \text{ кН},$$

$$Q = 8 \text{ кН},$$

$$\beta = 45^\circ.$$

Задача M8.11.

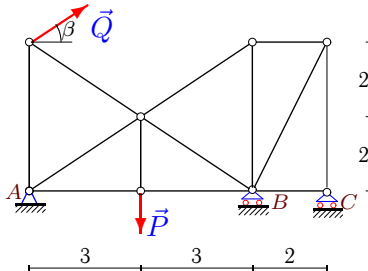
5



$P = 10 \text{ кН},$
 $Q = 9 \text{ кН},$
 $\beta = 15^\circ.$

Задача M8.12.

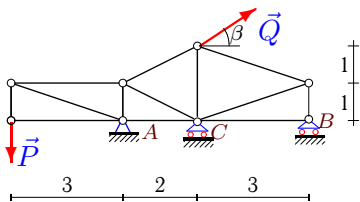
5



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

Задача M8.13.

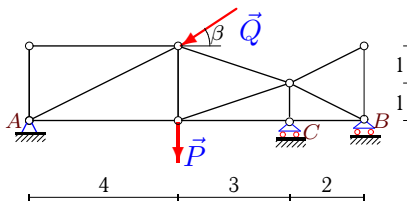
5



$P = 11 \text{ кН},$
 $Q = 7 \text{ кН},$
 $\beta = 45^\circ.$

Задача M8.14.

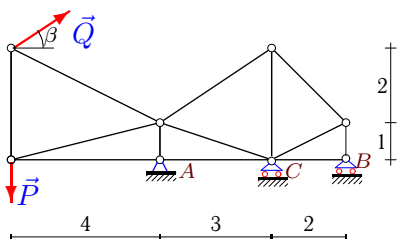
5



$P = 12 \text{ кН},$
 $Q = 7 \text{ кН},$
 $\beta = 45^\circ.$

Задача M8.15.

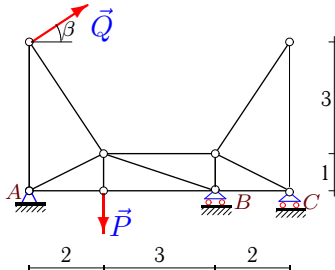
5



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

Задача M8.16.

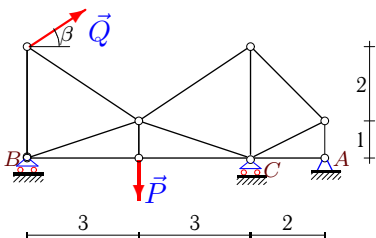
5



$P = 11 \text{ кН},$
 $Q = 4 \text{ кН},$
 $\beta = 45^\circ.$

Задача M8.17.

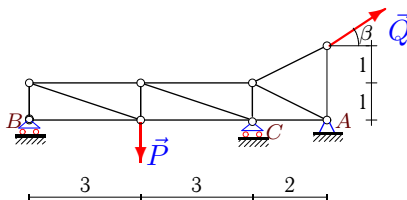
5



$P = 12 \text{ кН},$
 $Q = 8 \text{ кН},$
 $\beta = 30^\circ.$

Задача M8.18.

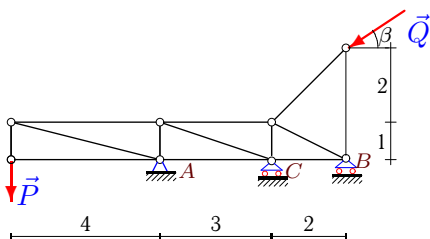
5



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

Задача M8.19.

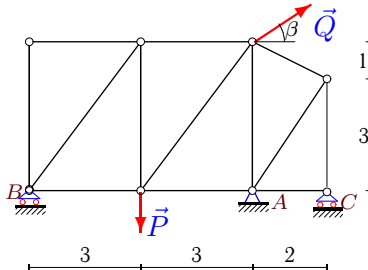
5



$P = 7 \text{ кН},$
 $Q = 9 \text{ кН},$
 $\beta = 30^\circ.$

Задача M8.20.

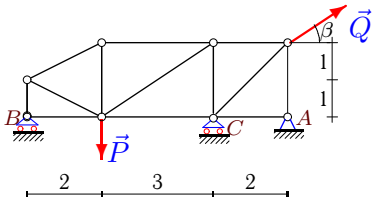
5



$P = 6 \text{ кН},$
 $Q = 8 \text{ кН},$
 $\beta = 15^\circ.$

Задача M8.21.

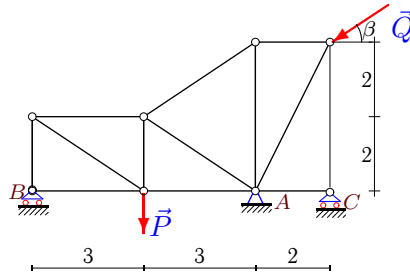
5



$P = 7 \text{ кН},$
 $Q = 6 \text{ кН},$
 $\beta = 45^\circ.$

Задача M8.22.

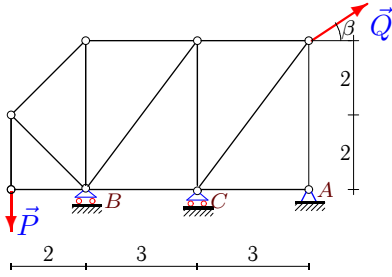
5



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

Задача M8.23.

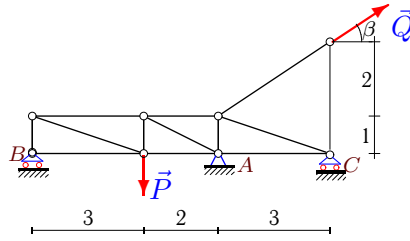
5



$P = 12 \text{ кН},$
 $Q = 3 \text{ кН},$
 $\beta = 15^\circ.$

Задача M8.24.

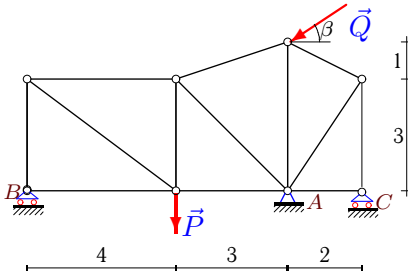
5



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

Задача M8.25.

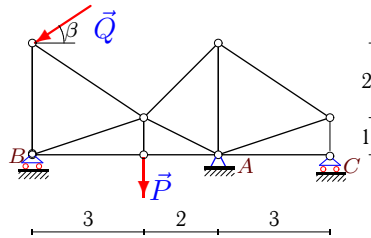
5



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

Задача M8.26.

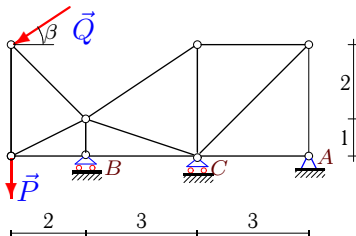
5



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

Задача M8.27.

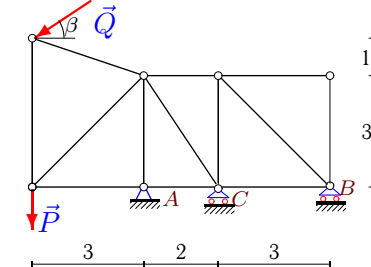
5



$P = 5 \text{ кН},$
 $Q = 9 \text{ кН},$
 $\beta = 15^\circ.$

Задача M8.28.

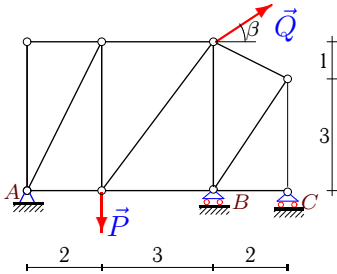
5



$P = 9 \text{ кН},$
 $Q = 7 \text{ кН},$
 $\beta = 30^\circ.$

Задача M8.29.

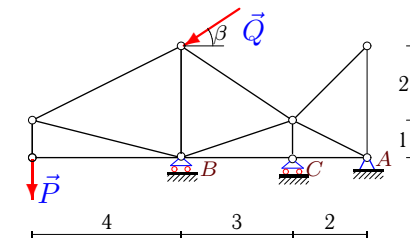
5



$P = 10 \text{ кН},$
 $Q = 5 \text{ кН},$
 $\beta = 15^\circ.$

Задача M8.30.

5



$P = 10 \text{ кН},$
 $Q = 3 \text{ кН},$
 $\beta = 30^\circ.$

М8 Ответы.**Расчет статически неопределимой фермы**

16.06.2012

| | δ_{11} | Δ_{1P} | X_A | Y_A | Y_B | Y_C |
|----|---------------|---------------|--------|---------|---------|---------|
| 1 | 45.499 | 20.352 | 3.864 | 7.800 | 4.682 | -0.447 |
| 2 | 24.122 | -24.463 | 5.796 | 10.560 | -1.021 | 1.014 |
| 3 | 14.945 | -8.899 | 6.364 | 12.232 | -0.463 | 0.595 |
| 4 | 42.549 | 97.691 | -6.364 | 2.682 | -0.750 | -2.296 |
| 5 | 46.604 | 23.103 | 4.243 | 11.141 | 2.597 | -0.496 |
| 6 | 15.787 | -72.229 | 8.693 | 12.537 | -1.783 | 4.575 |
| 7 | 15.226 | -193.043 | 6.364 | -3.788 | 4.473 | 12.679 |
| 8 | 18.694 | -60.745 | -8.693 | 2.788 | -0.367 | 3.249 |
| 9 | 16.020 | -19.520 | 3.864 | 5.518 | -0.702 | 1.219 |
| 10 | 11.309 | -128.296 | 5.657 | -3.306 | 8.618 | 11.345 |
| 11 | 28.329 | 288.710 | -8.693 | -3.439 | 21.301 | -10.191 |
| 12 | 14.639 | 45.621 | -2.598 | 0.229 | 10.387 | -3.117 |
| 13 | 5.562 | 43.632 | -4.950 | 17.357 | -3.462 | -7.844 |
| 14 | 27.063 | -257.517 | 4.950 | 8.402 | -0.968 | 9.516 |
| 15 | 4.601 | -4.427 | -4.830 | 15.988 | -6.244 | 0.962 |
| 16 | 42.229 | 34.046 | -2.828 | 1.186 | 7.791 | -0.806 |
| 17 | 11.632 | -288.176 | -6.928 | -11.483 | -5.292 | 24.775 |
| 18 | 25.554 | -37.143 | -4.830 | 1.448 | 2.804 | 1.454 |
| 19 | 16.805 | -109.553 | 7.794 | 14.669 | -9.688 | 6.519 |
| 20 | 11.295 | -57.901 | -7.727 | -0.754 | -0.443 | 5.126 |
| 21 | 8.401 | -6.157 | -4.243 | -1.554 | 3.578 | 0.733 |
| 22 | 15.083 | 53.256 | 5.196 | 8.744 | 4.787 | -3.531 |
| 23 | 6.750 | 11.563 | -2.898 | -1.988 | 14.925 | -1.713 |
| 24 | 109.952 | -45.416 | -7.794 | 3.416 | 2.671 | 0.413 |
| 25 | 10.961 | 81.316 | 7.794 | 15.870 | 7.048 | -7.419 |
| 26 | 53.085 | 144.852 | 7.794 | 5.089 | 11.139 | -2.729 |
| 27 | 6.385 | 4.681 | 8.693 | -6.423 | 14.486 | -0.733 |
| 28 | 5.593 | -1.885 | 6.062 | 24.648 | -12.485 | 0.337 |
| 29 | 12.053 | -30.460 | -4.830 | 3.147 | 3.031 | 2.527 |
| 30 | 17.285 | 176.675 | 2.598 | -3.426 | 25.147 | -10.222 |

М8 файл о8т5В

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

| | 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 | 4.086 0.333 | -0.000 2.000 | -0.000 2.000 | -0.000 0.000 | 9.638 0.556 | -4.086 1.333 | 0.000 0.000 | 0.000 0.000 | -4.911 -0.401 | 0.000 0.000 | -11.242 -0.471 | 4.307 -1.757 | 0.000 -2.236 |
| 2 | -0.371 -0.143 | -0.593 -1.429 | -0.593 -1.429 | 0.000 0.000 | 8.926 -0.429 | 0.000 -1.000 | 0.000 0.000 | 0.000 0.000 | 0.524 0.202 | 0.000 -0.000 | -12.130 0.319 | 0.235 1.355 | 0.663 1.597 |
| 3 | -0.546 -0.750 | -0.546 -0.750 | 0.000 0.000 | -9.546 0.000 | 6.000 0.000 | -0.091 -0.625 | 0.091 0.625 | 7.115 0.000 | 0.144 0.988 | 0.144 0.988 | -6.505 0.839 | 0.432 -0.198 | -0.144 -0.988 |
| 4 | 6.364 0.000 | 13.564 0.800 | 6.364 2.000 | -3.600 -0.400 | 2.400 -0.400 | 6.364 1.000 | 3.182 0.000 | -7.200 -0.800 | -0.000 -2.000 | 7.115 0.000 | 8.050 0.894 | -7.589 1.265 | -7.115 -2.236 |
| 5 | -4.243 0.000 | 0.000 2.000 | 0.000 2.000 | -11.340 -0.400 | 5.689 0.500 | -1.903 1.400 | 0.000 0.000 | -10.221 -0.361 | -2.018 -0.283 | 0.000 -0.000 | 6.339 0.224 | 1.504 -1.897 | 0.000 -2.236 |
| 6 | 6.460 -0.750 | 6.460 -0.750 | -0.000 0.000 | -6.676 0.000 | 13.000 0.000 | 0.538 -0.313 | -1.077 0.625 | 9.719 0.000 | -1.702 0.988 | -1.615 0.938 | -16.942 0.839 | -5.107 -0.198 | 1.941 -1.127 |
| 7 | 0.000 0.000 | 18.455 -0.750 | 6.364 0.000 | -9.227 0.375 | -2.227 0.375 | -0.106 -0.625 | -4.136 0.625 | -18.455 0.750 | -13.249 0.988 | -6.540 0.988 | 20.633 -0.839 | -6.205 -0.198 | 6.540 -0.988 |
| 8 | -1.727 0.381 | -8.693 1.000 | -0.000 1.000 | -0.000 0.000 | 3.356 0.413 | -6.966 1.286 | 0.000 0.000 | 0.000 0.000 | -7.343 -0.402 | 0.000 0.000 | 2.159 -0.476 | 8.372 -0.744 | 0.000 -1.414 |
| 9 | 0.120 -0.250 | 0.090 -0.938 | 0.090 -0.938 | 0.000 0.000 | 4.980 -0.458 | 0.000 -1.000 | 0.000 0.000 | 0.000 0.000 | -0.126 0.264 | -0.000 0.000 | -7.181 0.451 | 0.036 0.826 | -0.108 1.127 |
| 10 | 14.853 -0.296 | 11.174 -0.778 | 11.174 -0.778 | 0.000 -0.000 | 8.548 -0.321 | 0.000 -1.000 | -0.000 0.000 | 0.000 0.000 | -9.693 0.312 | 0.000 0.000 | -18.566 0.370 | 4.421 0.579 | -7.803 1.100 |
| 11 | 24.594 1.143 | 24.594 1.143 | 0.000 -0.000 | 4.503 0.000 | 10.000 0.000 | 0.000 0.333 | 0.000 -1.000 | -8.961 0.000 | -0.000 -1.054 | -0.000 -1.000 | -16.390 -1.178 | -25.925 -0.151 | 0.000 1.414 |
| 12 | 9.348 0.500 | 9.348 0.500 | 0.000 -0.000 | 3.232 0.000 | 9.000 0.000 | 0.000 0.333 | 0.000 -1.000 | -3.122 0.000 | -0.000 -0.601 | -0.000 -0.500 | -8.112 -0.601 | -11.235 0.000 | 0.000 1.118 |
| 13 | 0.000 0.000 | -28.050 -0.000 | 0.000 0.000 | 11.000 0.000 | -1.650 0.600 | -5.775 -0.500 | 6.600 0.400 | 33.000 0.000 | 16.603 0.671 | 10.436 0.632 | -34.785 -0.000 | 20.293 -0.671 | -10.436 -0.632 |
| 14 | 16.083 -0.444 | 12.867 -1.556 | 12.867 -1.556 | 0.000 -0.000 | 10.928 -0.370 | 0.000 -1.000 | 0.000 0.000 | 0.000 0.000 | -16.953 0.468 | -0.000 -0.000 | -23.516 0.497 | 3.391 1.171 | -14.385 1.739 |
| 15 | -33.164 0.000 | -28.335 0.000 | 0.000 0.000 | 3.709 0.000 | -16.373 0.400 | -6.297 -0.667 | 5.667 0.600 | -5.400 0.000 | 4.541 0.481 | 5.343 0.566 | 34.185 -0.000 | 25.885 -0.422 | -4.224 -0.447 |
| 16 | 19.988 0.800 | 19.988 0.800 | -0.000 2.000 | 7.071 0.000 | 11.000 0.000 | 0.000 1.000 | 0.000 0.000 | -5.099 -0.000 | 0.000 -2.000 | 0.000 -0.000 | -19.185 -0.894 | -21.069 1.265 | 0.000 -2.236 |
| 17 | 28.562 -0.750 | 28.562 -0.750 | -6.928 -0.000 | 8.619 -0.000 | 12.000 0.000 | 7.887 -0.833 | -7.998 0.750 | -8.327 0.000 | -5.687 0.601 | -6.692 0.707 | -30.107 0.791 | -32.422 0.264 | 5.291 -0.559 |
| 18 | 0.000 0.000 | 9.503 -0.750 | -1.994 -1.500 | -3.168 0.250 | 3.832 0.250 | 3.832 -0.750 | -1.121 0.000 | -9.503 0.750 | 1.994 1.500 | 5.400 -0.000 | 10.017 -0.791 | -12.119 -0.791 | -3.170 1.677 |
| 19 | 0.000 0.000 | -35.794 0.000 | -4.965 -1.200 | 7.000 0.000 | -10.277 0.400 | -10.277 -0.600 | 3.294 -0.000 | 28.000 -0.000 | -2.830 1.200 | -11.023 0.000 | -28.862 0.000 | 32.497 -1.265 | 5.551 1.342 |
| 20 | -1.614 0.250 | -7.727 0.500 | 0.000 0.000 | -0.000 0.000 | -2.152 0.333 | -6.081 0.583 | 0.000 -1.000 | 0.000 0.000 | 1.614 -0.250 | -0.000 -0.559 | 2.690 -0.417 | 10.190 -0.417 | 0.000 0.901 |
| 21 | 0.000 0.000 | -1.030 -0.714 | -4.243 0.000 | -3.788 0.286 | 1.894 -0.143 | -3.212 -0.286 | 1.030 0.714 | -4.235 0.319 | -3.788 0.286 | 1.030 0.714 | 4.235 -0.319 | 5.791 0.515 | 4.543 -1.010 |
| 22 | 0.000 0.000 | 8.946 0.500 | 0.000 -0.000 | -5.964 -0.333 | 1.036 -0.333 | 2.464 0.333 | 0.000 -1.000 | -8.946 -0.500 | -4.442 -0.601 | -3.696 -0.500 | 10.752 0.601 | -6.310 0.000 | -3.354 1.118 |
| 23 | 0.000 0.000 | -4.449 -0.375 | -2.898 -0.000 | 12.000 0.000 | -6.000 0.000 | 2.068 -0.500 | 2.845 0.500 | 8.485 0.000 | 6.000 0.000 | 4.449 0.375 | -8.485 -0.000 | -2.585 0.625 | -2.585 -0.625 |
| 24 | 0.000 0.000 | 7.270 1.800 | -2.088 3.000 | -2.423 -0.600 | 8.577 -0.600 | 4.500 1.000 | -0.696 0.000 | -7.270 -1.800 | 9.883 -3.000 | 9.367 -0.000 | 7.664 1.897 | -19.178 1.342 | 2.201 -3.162 |
| 25 | 0.000 0.000 | 12.224 0.381 | 0.000 0.000 | -9.168 -0.286 | 1.832 -0.286 | -1.902 0.417 | 0.000 -1.000 | -12.224 -0.381 | -8.216 -0.527 | 0.000 -0.559 | 15.280 0.476 | -6.265 0.168 | 0.000 0.901 |
| 26 | 9.241 1.800 | 9.241 1.800 | 0.000 0.000 | -9.696 0.000 | 9.000 0.000 | 0.000 1.667 | 0.000 -1.000 | 9.367 0.000 | -0.000 -1.414 | -0.000 -1.202 | -9.741 -1.897 | -1.618 -0.894 | 0.000 1.054 |
| 27 | -32.045 0.000 | -32.045 0.000 | 8.693 0.000 | -11.023 0.000 | -14.119 0.500 | -4.527 -0.333 | 6.790 0.500 | 12.294 0.000 | 8.160 0.601 | 6.790 0.500 | 35.828 -0.000 | 35.785 -0.527 | -9.602 -0.707 |
| 28 | -14.521 -0.000 | -20.583 -0.000 | -12.350 -0.400 | -5.521 -0.000 | -24.850 0.600 | -12.350 -0.400 | 0.000 0.000 | 6.390 0.000 | 12.350 0.400 | -0.000 0.000 | 20.535 0.000 | 14.843 -0.721 | 17.465 0.566 |
| 29 | 5.898 0.200 | 0.000 0.500 | 0.000 -0.000 | 0.000 0.000 | 2.136 0.400 | -6.570 0.650 | 0.000 -1.000 | 0.000 0.000 | -1.068 -0.200 | -0.000 -0.559 | -2.388 -0.447 | 9.830 -0.500 | 0.000 0.901 |
| 30 | 0.000 0.000 | -16.520 -1.200 | -16.520 -1.200 | 10.000 0.000 | -18.788 0.000 | 0.000 -1.000 | 0.000 -0.000 | 14.907 -0.000 | 19.147 -0.000 | 0.000 0.000 | -13.744 0.000 | 3.359 1.265 | 21.374 1.342 |