

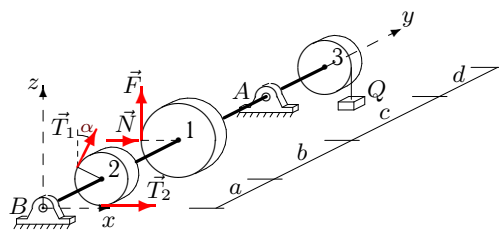
## Равновесие вала

Горизонтальный вал весом  $G$  может вращаться в цилиндрических шарнирах  $A$  и  $B$ . К шкиву 1 приложено нормальное давление  $N$  и касательная сила сопротивления  $F$ , пропорциональная  $N$ . На шкив 2 действуют силы натяжения ремней  $T_1$  и  $T_2$ . Груз  $Q$  висит на нити, навитой на шкив 3. Определить силу давления  $N$  и реакции шарниров в условии равновесия вала (в Н). Учесть веса шкивов  $P_1, P_2, P_3$ . Все нагрузки действуют в вертикальной плоскости. Силы даны в Н, размеры — в см.

Кирсанов М.Н. **Решебник. Теоретическая механика** с. 94.

### Вариант 1

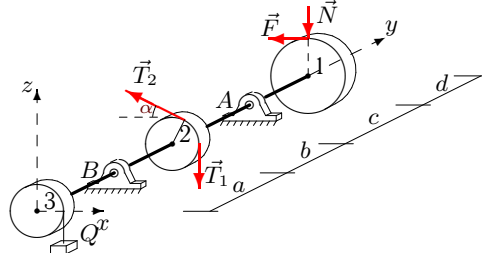
C19.



$$F = 0.1N, T_1 = 40, \\ T_2 = 76, P_1 = 30, \\ P_2 = 20, P_3 = 24, \\ Q = 22, G = 20, \\ \alpha = 45^\circ, R_1 = 24, \\ R_2 = 10, R_3 = 11, \\ a = 22, b = 26, \\ c = 28, d = 25.$$

### Вариант 2

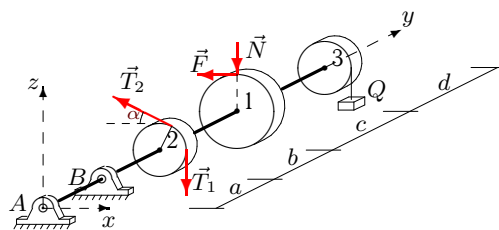
C19.



$$F = 0.1N, T_1 = 70, \\ T_2 = 36, P_1 = 28, \\ P_2 = 20, P_3 = 24, \\ Q = 10, G = 35, \\ \alpha = 45^\circ, R_1 = 20, \\ R_2 = 10, R_3 = 11, \\ a = 22, b = 23, \\ c = 25, d = 24.$$

### Вариант 3

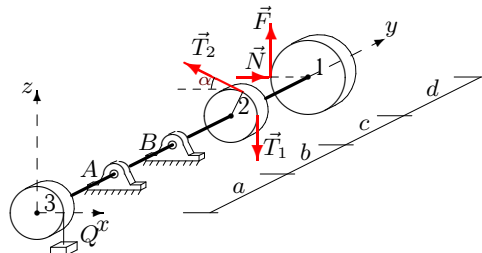
C19.



$$F = 0.2N, T_1 = 30, \\ T_2 = 17, P_1 = 28, \\ P_2 = 20, P_3 = 24, \\ Q = 10, G = 15, \\ \alpha = 45^\circ, R_1 = 20, \\ R_2 = 10, R_3 = 11, \\ a = 22, b = 23, \\ c = 25, d = 24.$$

### Вариант 4

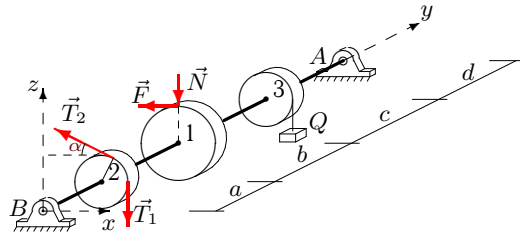
C19.



$$F = 0.4N, T_1 = 70, \\ T_2 = 137, P_1 = 20, \\ P_2 = 10, P_3 = 18, \\ Q = 18, G = 35, \\ \alpha = 30^\circ, R_1 = 14, \\ R_2 = 8, R_3 = 10, \\ a = 24, b = 27, \\ c = 28, d = 25.$$

**Вариант 5**

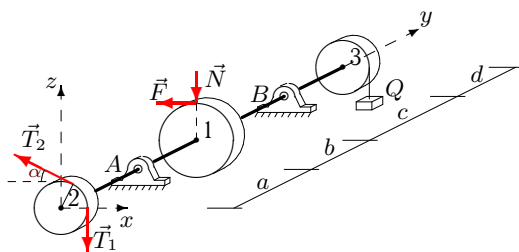
C19.



$$F = 0.4N, T_1 = 40, \\ T_2 = 24, P_1 = 32, \\ P_2 = 20, P_3 = 28, \\ Q = 26, G = 20, \\ \alpha = 45^\circ, R_1 = 20, \\ R_2 = 10, R_3 = 12, \\ a = 24, b = 29, \\ c = 31, d = 26.$$

**Вариант 6**

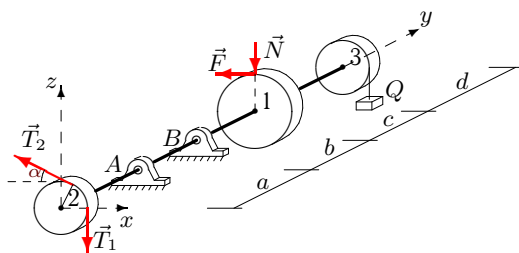
C19.



$$F = 0.2N, T_1 = 50, \\ T_2 = 27, P_1 = 36, \\ P_2 = 30, P_3 = 34, \\ Q = 26, G = 25, \\ \alpha = 60^\circ, R_1 = 18, \\ R_2 = 12, R_3 = 13, \\ a = 22, b = 27, \\ c = 30, d = 23.$$

**Вариант 7**

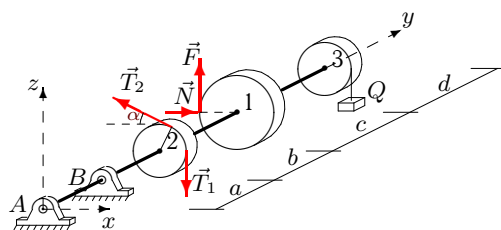
C19.



$$F = 0.3N, T_1 = 50, \\ T_2 = 28, P_1 = 20, \\ P_2 = 10, P_3 = 18, \\ Q = 10, G = 25, \\ \alpha = 30^\circ, R_1 = 14, \\ R_2 = 8, R_3 = 10, \\ a = 24, b = 25, \\ c = 26, d = 25.$$

**Вариант 8**

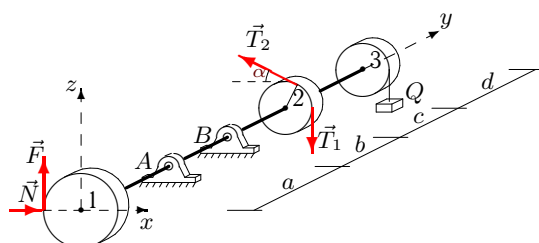
C19.



$$F = 0.1N, T_1 = 30, \\ T_2 = 57, P_1 = 26, \\ P_2 = 20, P_3 = 24, \\ Q = 18, G = 15, \\ \alpha = 45^\circ, R_1 = 16, \\ R_2 = 10, R_3 = 11, \\ a = 22, b = 25, \\ c = 27, d = 23.$$

**Вариант 9**

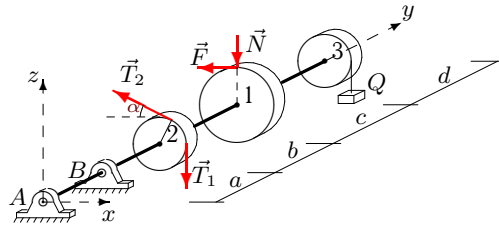
C19.



$$F = 0.2N, T_1 = 60, \\ T_2 = 118, P_1 = 26, \\ P_2 = 20, P_3 = 24, \\ Q = 14, G = 30, \\ \alpha = 45^\circ, R_1 = 16, \\ R_2 = 10, R_3 = 11, \\ a = 22, b = 24, \\ c = 26, d = 23.$$

**Вариант 10**

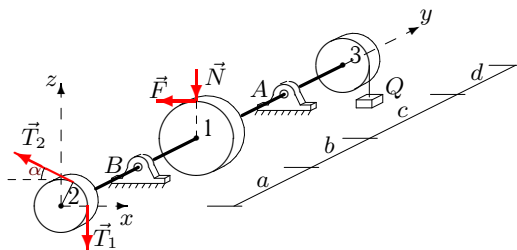
C19.



$$F = 0.2N, T_1 = 30, \\ T_2 = 17, P_1 = 18, \\ P_2 = 10, P_3 = 14, \\ Q = 26, G = 15, \\ \alpha = 30^\circ, R_1 = 18, \\ R_2 = 8, R_3 = 9, \\ a = 22, b = 27, \\ c = 28, d = 24.$$

**Вариант 11**

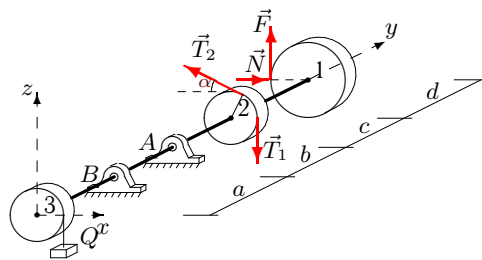
C19.



$$F = 0.1N, T_1 = 50, \\ T_2 = 26, P_1 = 28, \\ P_2 = 20, P_3 = 24, \\ Q = 26, G = 25, \\ \alpha = 45^\circ, R_1 = 20, \\ R_2 = 10, R_3 = 11, \\ a = 22, b = 27, \\ c = 29, d = 24.$$

**Вариант 12**

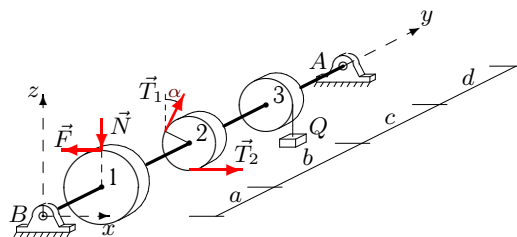
C19.



$$F = 0.2N, T_1 = 70, \\ T_2 = 136, P_1 = 18, \\ P_2 = 10, P_3 = 14, \\ Q = 22, G = 35, \\ \alpha = 30^\circ, R_1 = 18, \\ R_2 = 8, R_3 = 9, \\ a = 22, b = 26, \\ c = 27, d = 24.$$

**Вариант 13**

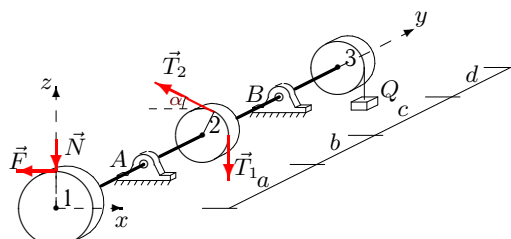
C19.



$$F = 0.4N, T_1 = 40, \\ T_2 = 24, P_1 = 46, \\ P_2 = 30, P_3 = 38, \\ Q = 26, G = 20, \\ \alpha = 60^\circ, R_1 = 30, \\ R_2 = 12, R_3 = 14, \\ a = 24, b = 29, \\ c = 32, d = 28.$$

**Вариант 14**

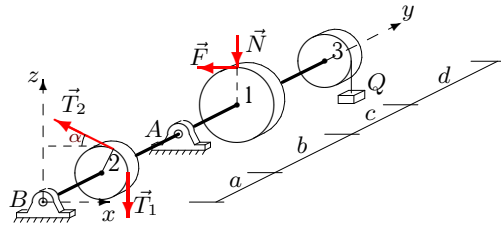
C19.



$$F = 0.2N, T_1 = 60, \\ T_2 = 32, P_1 = 36, \\ P_2 = 30, P_3 = 34, \\ Q = 10, G = 30, \\ \alpha = 60^\circ, R_1 = 18, \\ R_2 = 12, R_3 = 13, \\ a = 22, b = 23, \\ c = 26, d = 23.$$

**Вариант 15**

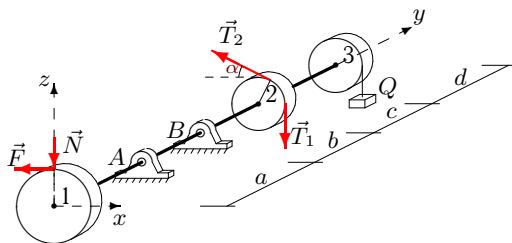
C19.



$F = 0.4N, T_1 = 40,$   
 $T_2 = 24, P_1 = 22,$   
 $P_2 = 10, P_3 = 18,$   
 $Q = 26, G = 20,$   
 $\alpha = 30^\circ, R_1 = 18,$   
 $R_2 = 8, R_3 = 10,$   
 $a = 24, b = 29,$   
 $c = 30, d = 26.$

**Вариант 16**

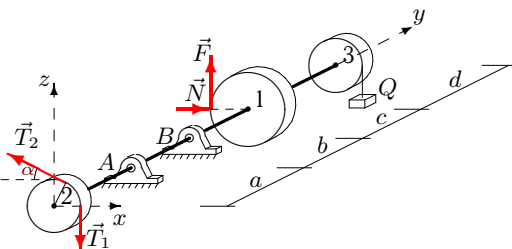
C19.



$F = 0.3N, T_1 = 60,$   
 $T_2 = 33, P_1 = 20,$   
 $P_2 = 10, P_3 = 18,$   
 $Q = 10, G = 30,$   
 $\alpha = 30^\circ, R_1 = 14,$   
 $R_2 = 8, R_3 = 10,$   
 $a = 24, b = 25,$   
 $c = 26, d = 25.$

**Вариант 17**

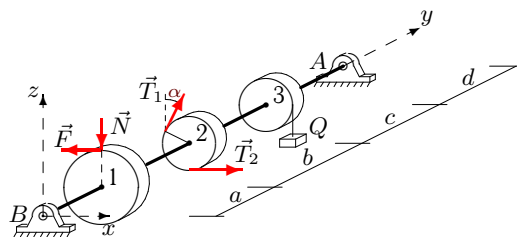
C19.



$F = 0.3N, T_1 = 50,$   
 $T_2 = 98, P_1 = 30,$   
 $P_2 = 20, P_3 = 28,$   
 $Q = 14, G = 25,$   
 $\alpha = 45^\circ, R_1 = 16,$   
 $R_2 = 10, R_3 = 12,$   
 $a = 24, b = 26,$   
 $c = 28, d = 25.$

**Вариант 18**

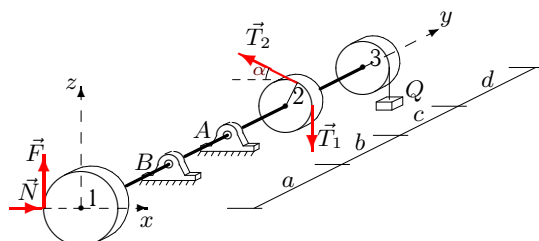
C19.



$F = 0.4N, T_1 = 40,$   
 $T_2 = 24, P_1 = 36,$   
 $P_2 = 20, P_3 = 28,$   
 $Q = 26, G = 20,$   
 $\alpha = 45^\circ, R_1 = 28,$   
 $R_2 = 10, R_3 = 12,$   
 $a = 24, b = 29,$   
 $c = 31, d = 28.$

**Вариант 19**

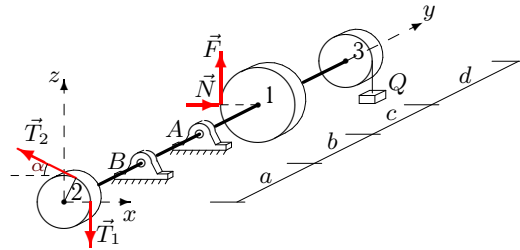
C19.



$F = 0.4N, T_1 = 60,$   
 $T_2 = 116, P_1 = 22,$   
 $P_2 = 10, P_3 = 18,$   
 $Q = 22, G = 30,$   
 $\alpha = 30^\circ, R_1 = 18,$   
 $R_2 = 8, R_3 = 10,$   
 $a = 24, b = 28,$   
 $c = 29, d = 26.$

**Вариант 20**

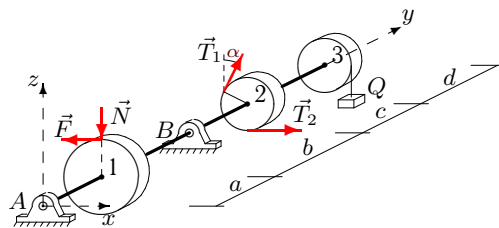
C19.



$F = 0.1N, T_1 = 50,$   
 $T_2 = 96, P_1 = 18,$   
 $P_2 = 10, P_3 = 14,$   
 $Q = 22, G = 25,$   
 $\alpha = 30^\circ, R_1 = 18,$   
 $R_2 = 8, R_3 = 9,$   
 $a = 22, b = 26,$   
 $c = 27, d = 24.$

**Вариант 21**

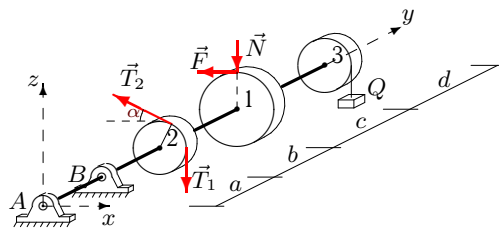
C19.



$F = 0.2N, T_1 = 30,$   
 $T_2 = 17, P_1 = 32,$   
 $P_2 = 20, P_3 = 24,$   
 $Q = 10, G = 15,$   
 $\alpha = 45^\circ, R_1 = 28,$   
 $R_2 = 10, R_3 = 11,$   
 $a = 22, b = 23,$   
 $c = 25, d = 26.$

**Вариант 22**

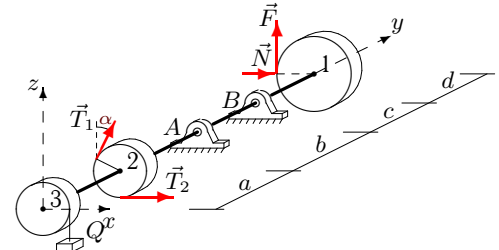
C19.



$F = 0.1N, T_1 = 30,$   
 $T_2 = 16, P_1 = 16,$   
 $P_2 = 10, P_3 = 14,$   
 $Q = 26, G = 15,$   
 $\alpha = 30^\circ, R_1 = 14,$   
 $R_2 = 8, R_3 = 9,$   
 $a = 22, b = 27,$   
 $c = 28, d = 23.$

**Вариант 23**

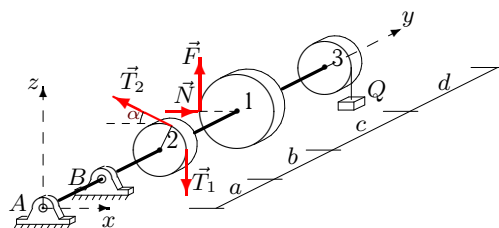
C19.



$F = 0.3N, T_1 = 70,$   
 $T_2 = 137, P_1 = 24,$   
 $P_2 = 10, P_3 = 18,$   
 $Q = 18, G = 35,$   
 $\alpha = 30^\circ, R_1 = 22,$   
 $R_2 = 8, R_3 = 10,$   
 $a = 24, b = 27,$   
 $c = 28, d = 27.$

**Вариант 24**

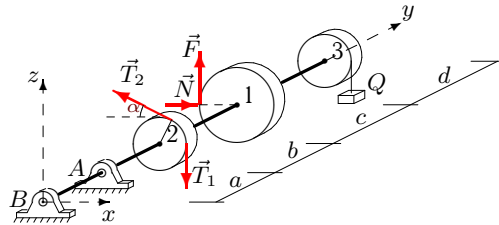
C19.



$F = 0.1N, T_1 = 30,$   
 $T_2 = 58, P_1 = 18,$   
 $P_2 = 10, P_3 = 14,$   
 $Q = 14, G = 15,$   
 $\alpha = 30^\circ, R_1 = 18,$   
 $R_2 = 8, R_3 = 9,$   
 $a = 22, b = 24,$   
 $c = 25, d = 24.$

**Вариант 25**

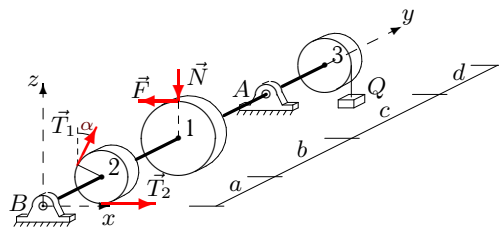
C19.



$F = 0.3N$ ,  $T_1 = 40$ ,  
 $T_2 = 76$ ,  $P_1 = 30$ ,  
 $P_2 = 20$ ,  $P_3 = 28$ ,  
 $Q = 22$ ,  $G = 20$ ,  
 $\alpha = 45^\circ$ ,  $R_1 = 16$ ,  
 $R_2 = 10$ ,  $R_3 = 12$ ,  
 $a = 24$ ,  $b = 28$ ,  
 $c = 30$ ,  $d = 25$ .

**Вариант 26**

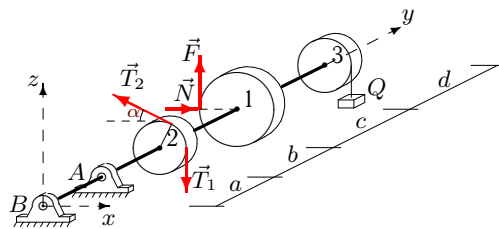
C19.



$F = 0.1N$ ,  $T_1 = 40$ ,  
 $T_2 = 21$ ,  $P_1 = 40$ ,  
 $P_2 = 30$ ,  $P_3 = 34$ ,  
 $Q = 26$ ,  $G = 20$ ,  
 $\alpha = 60^\circ$ ,  $R_1 = 26$ ,  
 $R_2 = 12$ ,  $R_3 = 13$ ,  
 $a = 22$ ,  $b = 27$ ,  
 $c = 30$ ,  $d = 25$ .

**Вариант 27**

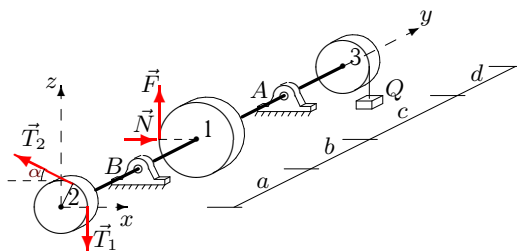
C19.



$F = 0.2N$ ,  $T_1 = 40$ ,  
 $T_2 = 77$ ,  $P_1 = 16$ ,  
 $P_2 = 10$ ,  $P_3 = 14$ ,  
 $Q = 18$ ,  $G = 20$ ,  
 $\alpha = 30^\circ$ ,  $R_1 = 14$ ,  
 $R_2 = 8$ ,  $R_3 = 9$ ,  
 $a = 22$ ,  $b = 25$ ,  
 $c = 26$ ,  $d = 23$ .

**Вариант 28**

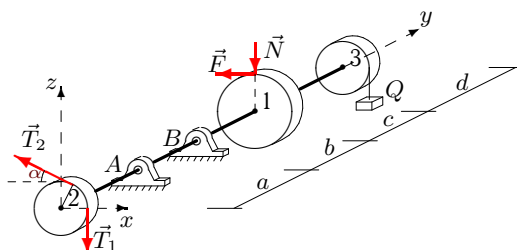
C19.



$F = 0.1N$ ,  $T_1 = 50$ ,  
 $T_2 = 97$ ,  $P_1 = 38$ ,  
 $P_2 = 30$ ,  $P_3 = 34$ ,  
 $Q = 18$ ,  $G = 25$ ,  
 $\alpha = 60^\circ$ ,  $R_1 = 22$ ,  
 $R_2 = 12$ ,  $R_3 = 13$ ,  
 $a = 22$ ,  $b = 25$ ,  
 $c = 28$ ,  $d = 24$ .

**Вариант 29**

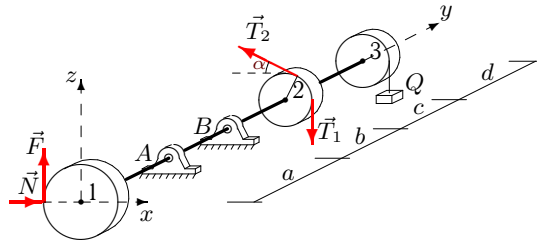
C19.



$F = 0.1N$ ,  $T_1 = 50$ ,  
 $T_2 = 26$ ,  $P_1 = 16$ ,  
 $P_2 = 10$ ,  $P_3 = 14$ ,  
 $Q = 26$ ,  $G = 25$ ,  
 $\alpha = 30^\circ$ ,  $R_1 = 14$ ,  
 $R_2 = 8$ ,  $R_3 = 9$ ,  
 $a = 22$ ,  $b = 27$ ,  
 $c = 28$ ,  $d = 23$ .

**Вариант 30**

**С19.**



$F = 0.4N$ ,  $T_1 = 60$ ,  
 $T_2 = 118$ ,  $P_1 = 20$ ,  
 $P_2 = 10$ ,  $P_3 = 18$ ,  
 $Q = 14$ ,  $G = 30$ ,  
 $\alpha = 30^\circ$ ,  $R_1 = 14$ ,  
 $R_2 = 8$ ,  $R_3 = 10$ ,  
 $a = 24$ ,  $b = 26$ ,  
 $c = 27$ ,  $d = 25$ .

Ответы

	$N$	$X_A$	$Z_A$	$X_B$	$Z_B$
1	49.167	-61.240	87.865	-92.211	-5.066
2	225.000	45.948	413.073	2.008	-26.529
3	60.000	-38.749	-360.024	62.770	535.003
4	63.571	1.749	65.434	53.325	11.638
5	59.000	15.074	104.470	25.497	103.559
6	170.556	36.664	175.253	10.947	172.920
7	65.714	27.025	-57.103	16.938	241.817
8	45.000	60.562	-223.085	-65.257	311.280
9	133.125	-345.548	-76.931	295.862	140.867
10	93.889	-65.013	-481.449	98.513	679.838
11	263.000	5.458	204.401	39.227	213.214
12	91.667	-31.385	30.032	57.498	52.635
13	46.333	-23.568	82.442	-16.540	103.891
14	129.444	46.002	266.817	-4.113	34.915
15	53.889	43.169	247.109	-0.829	-69.220
16	75.238	14.518	72.707	36.632	134.031
17	65.000	203.262	-97.012	-198.966	175.216
18	42.143	-21.129	63.325	-14.298	80.534
19	31.667	231.649	166.607	-162.856	-75.274
20	94.444	-262.869	140.344	251.563	-58.788
21	42.857	25.611	-0.599	-55.252	123.243
22	247.143	-78.791	-858.039	117.362	1208.182
23	53.939	-285.844	27.097	59.905	1.100
24	54.444	66.467	-150.260	-70.682	216.816
25	20.000	48.104	363.063	-14.363	-262.803
26	217.692	-1.993	254.771	-31.879	92.921
27	47.857	-16.338	229.172	35.164	-159.244
28	150.000	-90.887	101.030	-10.613	-5.035
29	304.286	9.308	-323.333	43.637	755.619
30	57.857	-217.385	-82.621	261.719	152.478