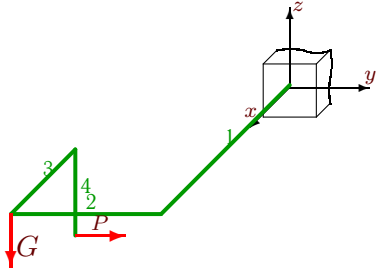


Деформации изогнутого стержня

Участки изогнутого стержня параллельны осям координат. К стержню приложены силы G и P . Построить эпюры изгибающих и крутящих моментов. Определить перемещения конца стержня (в см) по направлению действия силы P , пренебрегая весом стержня и влиянием нормальных и перерезывающих сил. Найти угол поворота конечного сечения относительно оси участка 4. Принять жесткость на изгиб $EJ_x = EJ_y = 9.8 \cdot 10^5 \text{ Нм}^2$, на кручение $EJ_0 = 7.6 \cdot 10^5 \text{ Нм}^2$.

Задача M26.1.

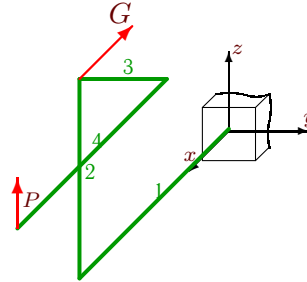
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 1 \text{ м}, \\ L_4 &= 1 \text{ м}, \\ P &= 3 \text{ кН}, \\ G &= 4 \text{ кН}. \end{aligned}$$

Задача M26.2.

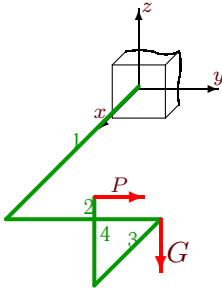
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 1 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 1 \text{ кН}, \\ G &= 4 \text{ кН}. \end{aligned}$$

Задача M26.3.

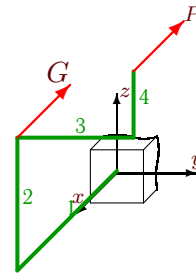
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 1 \text{ м}, \\ L_4 &= 1 \text{ м}, \\ P &= 2 \text{ кН}, \\ G &= 3 \text{ кН}. \end{aligned}$$

Задача M26.4.

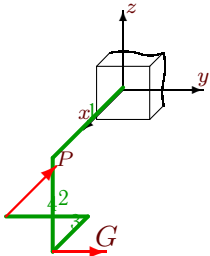
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 2 \text{ м}, \\ L_4 &= 1 \text{ м}, \\ P &= 2 \text{ кН}, \\ G &= 1 \text{ кН}. \end{aligned}$$

Задача M26.5.

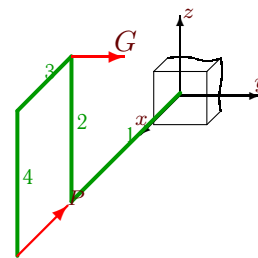
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 1 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 3 \text{ кН}, \\ G &= 2 \text{ кН}. \end{aligned}$$

Задача M26.6.

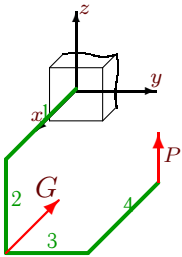
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 1 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 1 \text{ кН}, \\ G &= 1 \text{ кН}. \end{aligned}$$

Задача M26.7.

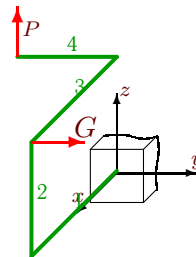
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 2 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 2 \text{ кН}, \\ G &= 3 \text{ кН}. \end{aligned}$$

Задача M26.8.

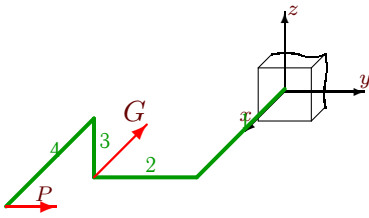
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 2 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 1 \text{ кН}, \\ G &= 1 \text{ кН}. \end{aligned}$$

Задача M26.9.

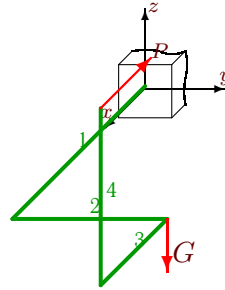
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 1 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 2 \text{ кН}, \\ G &= 5 \text{ кН}. \end{aligned}$$

Задача M26.10.

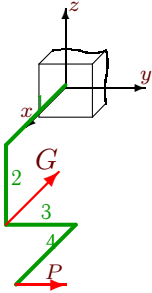
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 1 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 3 \text{ кН}, \\ G &= 5 \text{ кН}. \end{aligned}$$

Задача M26.11.

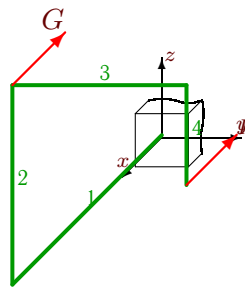
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 2 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 3 \text{ кН}, \\ G &= 4 \text{ кН}. \end{aligned}$$

Задача M26.12.

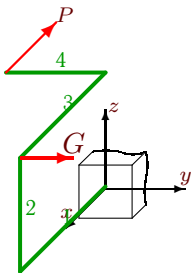
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 2 \text{ м}, \\ L_4 &= 1 \text{ м}, \\ P &= 3 \text{ кН}, \\ G &= 2 \text{ кН}. \end{aligned}$$

Задача M26.13.

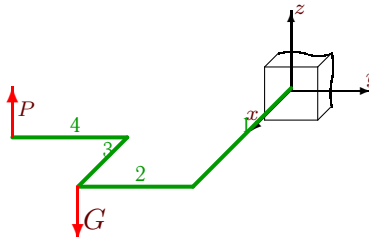
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 2 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 3 \text{ кН}, \\ G &= 4 \text{ кН}. \end{aligned}$$

Задача M26.14.

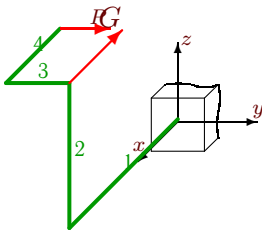
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 1 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 2 \text{ кН}, \\ G &= 5 \text{ кН}. \end{aligned}$$

Задача M26.15.

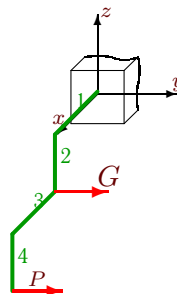
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 1 \text{ м}, \\ L_4 &= 1 \text{ м}, \\ P &= 1 \text{ кН}, \\ G &= 5 \text{ кН}. \end{aligned}$$

Задача M26.16.

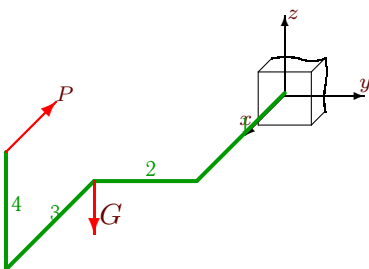
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 2 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 3 \text{ кН}, \\ G &= 5 \text{ кН}. \end{aligned}$$

Задача M26.17.

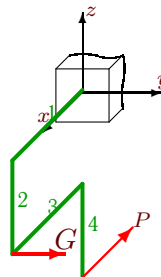
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 2 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 3 \text{ кН}, \\ G &= 3 \text{ кН}. \end{aligned}$$

Задача M26.18.

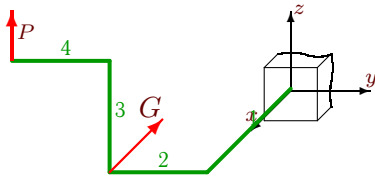
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 2 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 2 \text{ кН}, \\ G &= 3 \text{ кН}. \end{aligned}$$

Задача M26.19.

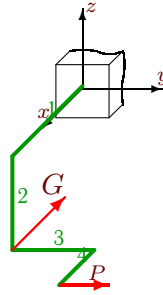
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 2 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 2 \text{ кН}, \\ G &= 1 \text{ кН}. \end{aligned}$$

Задача M26.20.

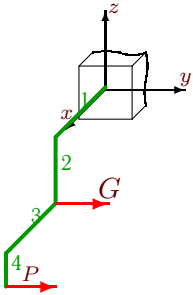
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 2 \text{ м}, \\ L_4 &= 1 \text{ м}, \\ P &= 2 \text{ кН}, \\ G &= 5 \text{ кН}. \end{aligned}$$

Задача M26.21.

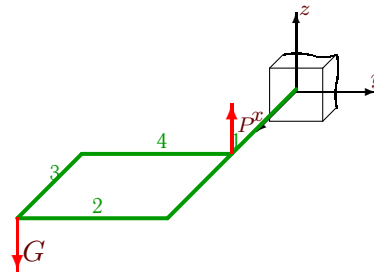
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 2 \text{ м}, \\ L_4 &= 1 \text{ м}, \\ P &= 1 \text{ кН}, \\ G &= 1 \text{ кН}. \end{aligned}$$

Задача M26.22.

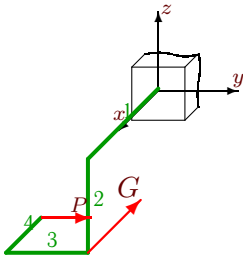
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 1 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 2 \text{ кН}, \\ G &= 5 \text{ кН}. \end{aligned}$$

Задача M26.23.

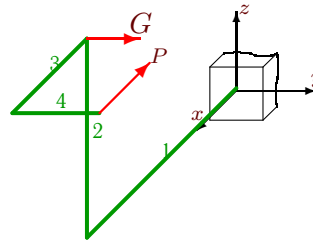
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 2 \text{ м}, \\ L_4 &= 1 \text{ м}, \\ P &= 3 \text{ кН}, \\ G &= 1 \text{ кН}. \end{aligned}$$

Задача M26.24.

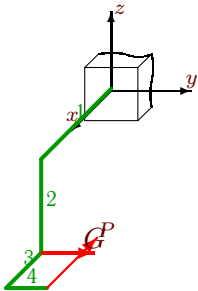
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 1 \text{ м}, \\ L_4 &= 1 \text{ м}, \\ P &= 2 \text{ кН}, \\ G &= 5 \text{ кН}. \end{aligned}$$

Задача M26.25.

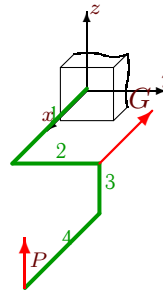
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 1 \text{ м}, \\ L_4 &= 1 \text{ м}, \\ P &= 3 \text{ кН}, \\ G &= 2 \text{ кН}. \end{aligned}$$

Задача M26.26.

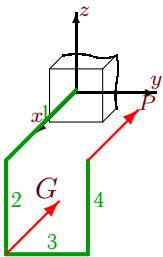
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 1 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 2 \text{ кН}, \\ G &= 1 \text{ кН}. \end{aligned}$$

Задача M26.27.

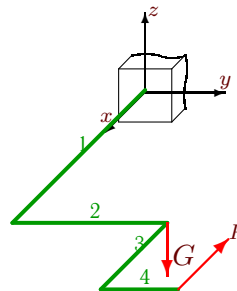
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 2 \text{ м}, \\ L_4 &= 2 \text{ м}, \\ P &= 1 \text{ кН}, \\ G &= 3 \text{ кН}. \end{aligned}$$

Задача M26.28.

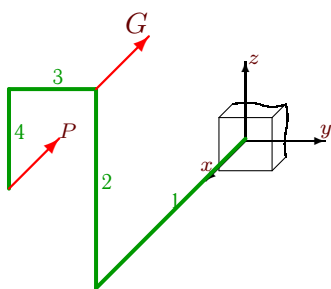
4



$$\begin{aligned} L_1 &= 2 \text{ м}, \\ L_2 &= 2 \text{ м}, \\ L_3 &= 1 \text{ м}, \\ L_4 &= 1 \text{ м}, \\ P &= 3 \text{ кН}, \\ G &= 2 \text{ кН}. \end{aligned}$$

Задача M26.29.

4



$$L_1 = 2 \text{ м},$$

$$L_2 = 2 \text{ м},$$

$$L_3 = 1 \text{ м},$$

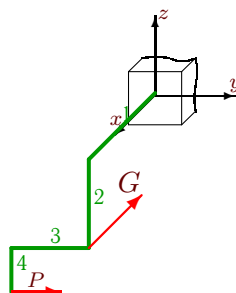
$$L_4 = 1 \text{ м},$$

$$P = 1 \text{ кН},$$

$$G = 2 \text{ кН}.$$

Задача M26.30.

4



$$L_1 = 2 \text{ м},$$

$$L_2 = 2 \text{ м},$$

$$L_3 = 2 \text{ м},$$

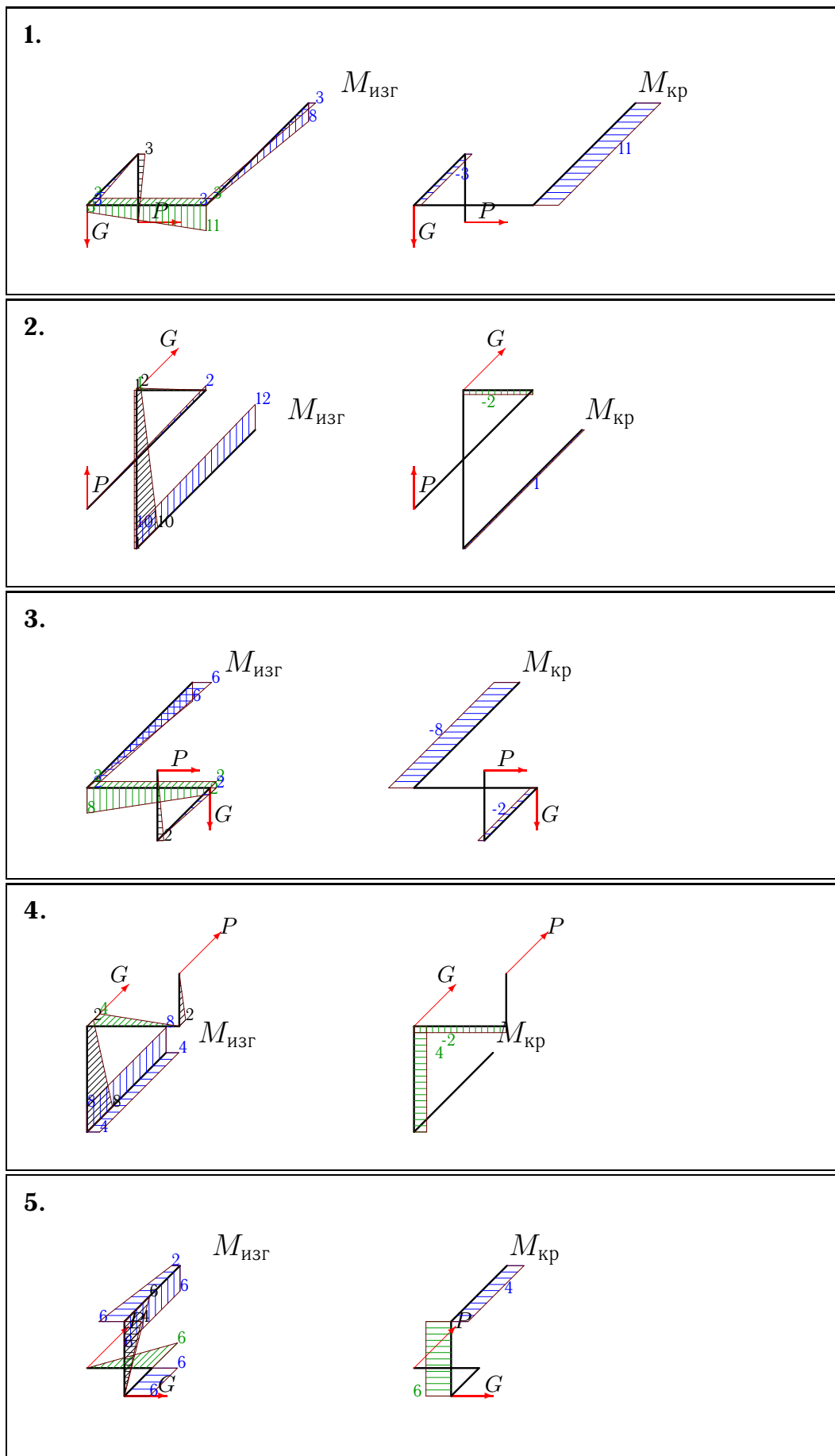
$$L_4 = 1 \text{ м},$$

$$P = 1 \text{ кН},$$

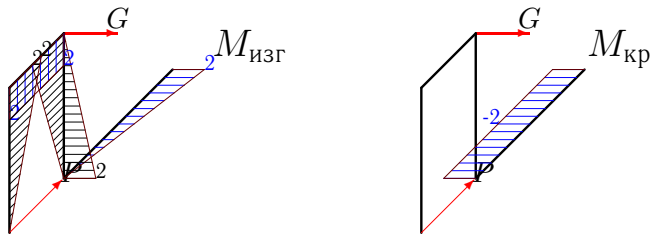
$$G = 3 \text{ кН}.$$

M26 Ответы.
Деформации изогнутого стержня

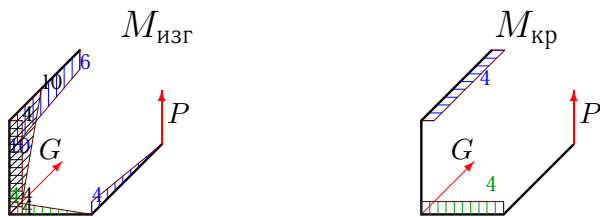
10.04.2013



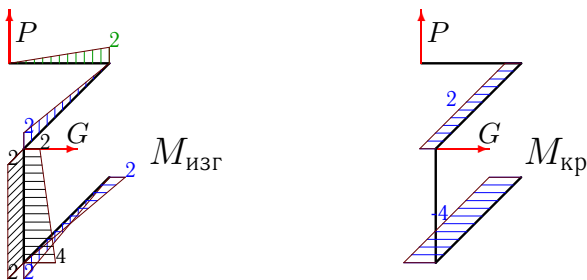
6.



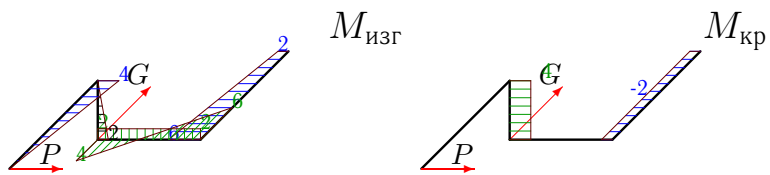
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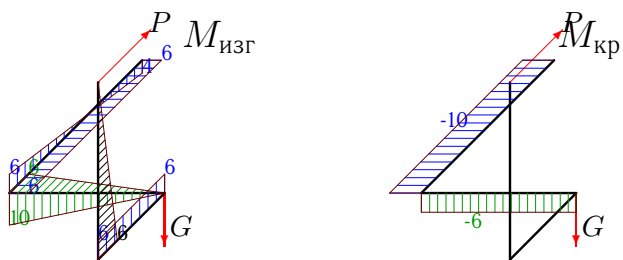
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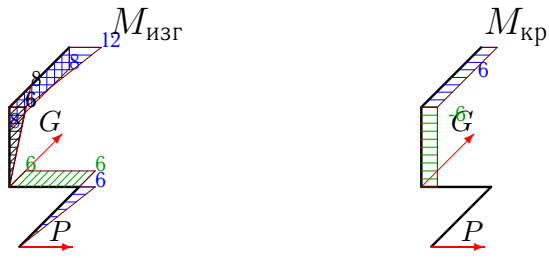
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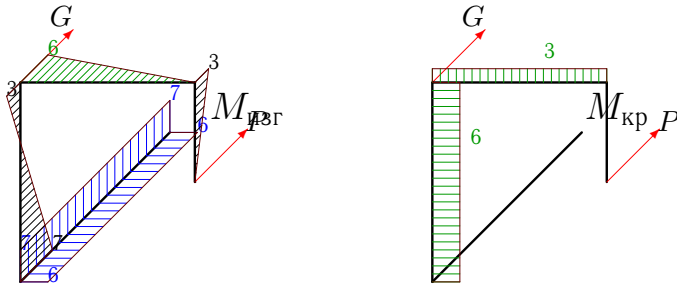
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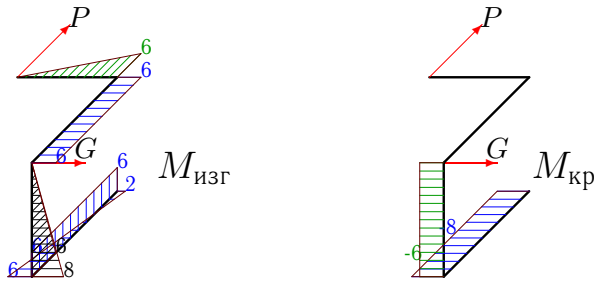
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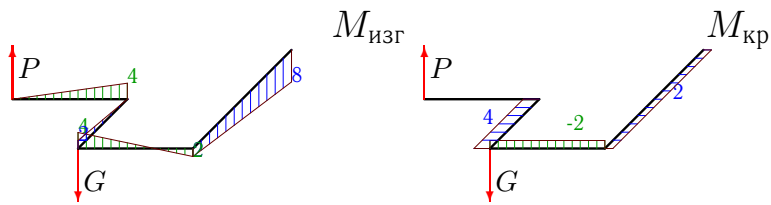
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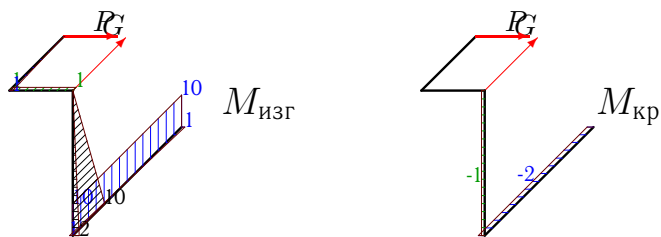
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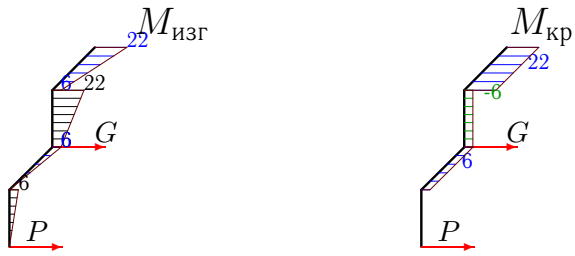
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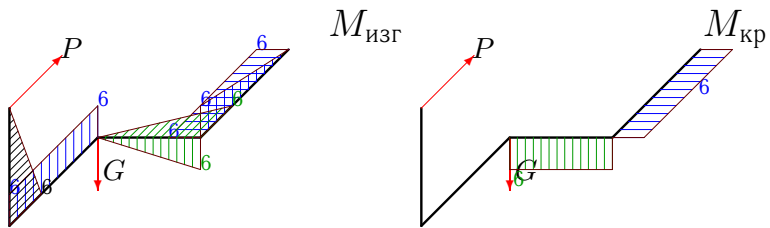
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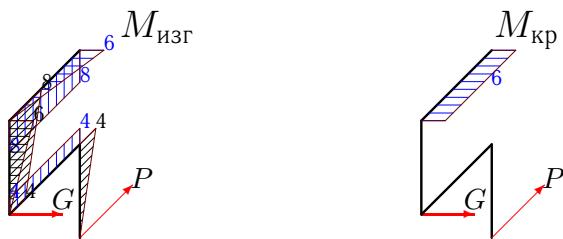
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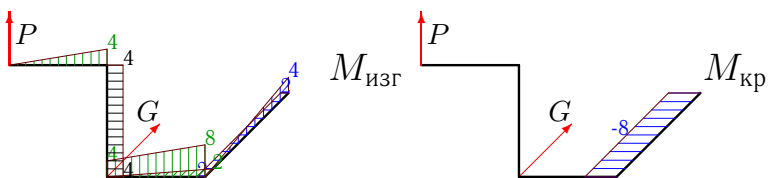
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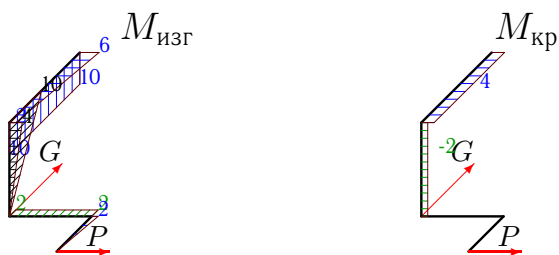
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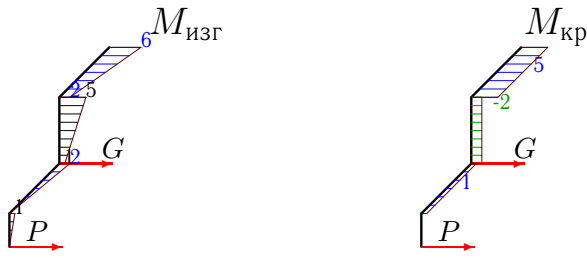
19.



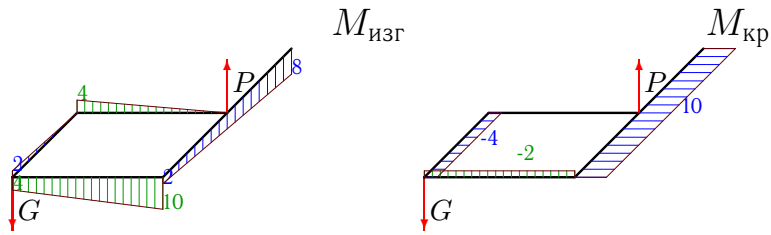
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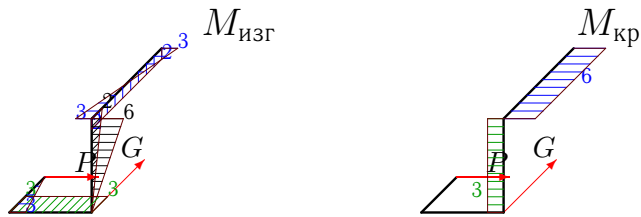
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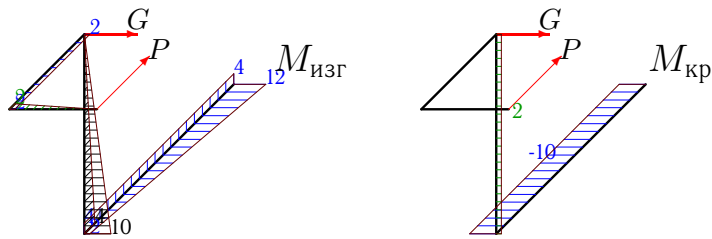
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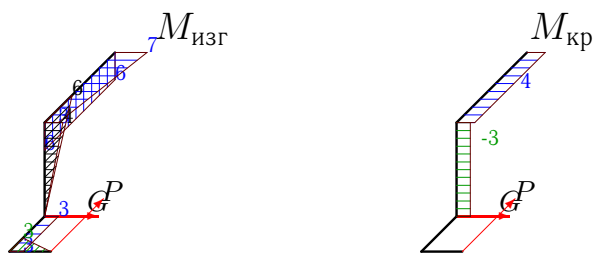
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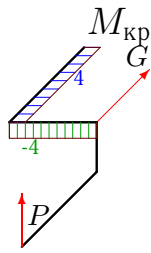
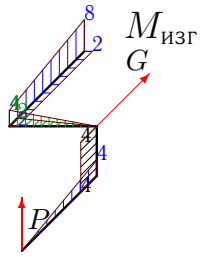
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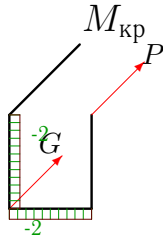
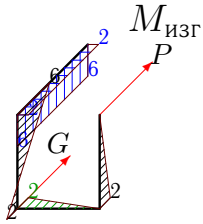
25.



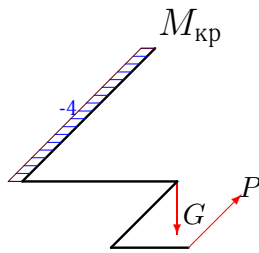
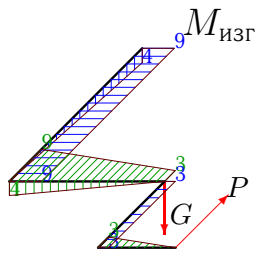
26.



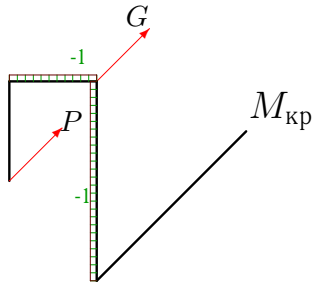
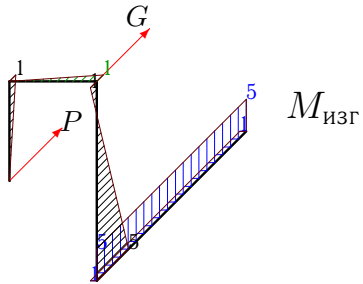
27.



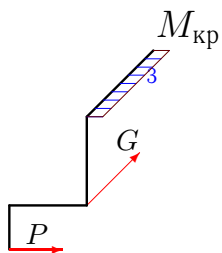
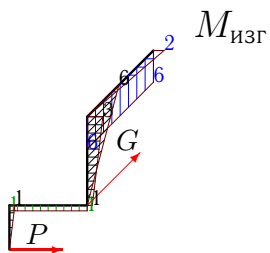
28.



29.



30.



№	Δ_{1-2}	Δ_{2-3}	Δ_{3-4}	Δ_{4-5}	$\sum \Delta$	$\Delta\varphi \cdot 10^2$
1	3.099	2.041	0.497	0.102	5.738	-0.765
2	7.066	2.653	0.560	0.272	10.551	0.518
3	3.874	1.429	0.331	0.068	5.702	1.327
4	6.531	4.350	1.071	0.068	12.019	2.277
5	4.082	3.974	1.224	0.816	10.097	1.837
6	0.000	0.272	0.408	0.272	0.952	0.204
7	3.874	4.490	2.649	0.544	11.557	2.277
8	2.377	2.041	1.325	0.272	6.015	0.816
9	-1.787	-0.000	1.121	0.544	-0.122	-1.037
10	2.857	3.974	1.224	0.816	8.872	1.837
11	8.872	3.974	2.449	0.816	16.112	2.191
12	3.878	3.498	1.606	0.102	9.083	3.416
13	3.265	3.974	2.449	0.816	10.505	-1.837
14	-2.309	0.934	1.121	0.544	0.290	1.649
15	1.121	0.535	0.102	0.034	1.792	-0.730
16	32.274	12.274	3.974	0.816	49.338	5.048
17	3.673	3.974	2.449	0.816	10.913	-1.837
18	6.531	3.810	1.633	0.544	12.517	0.612
19	8.965	3.810	1.633	0.544	14.952	-0.408
20	3.874	1.071	0.408	0.068	5.421	1.461
21	6.532	2.413	0.535	0.034	9.515	1.547
22	-0.204	1.751	1.121	0.544	3.212	1.649
23	3.362	1.606	0.612	0.102	5.682	2.191
24	3.061	1.071	0.204	0.068	4.404	-1.224
25	3.469	1.606	0.306	0.102	5.483	1.837
26	5.915	2.649	0.816	0.544	9.925	1.461
27	0.816	0.917	1.325	0.272	3.330	1.139
28	5.510	2.653	0.306	0.102	8.571	0.408
29	1.224	0.467	0.166	0.034	1.891	-0.518
30	2.641	0.884	0.204	0.034	3.763	0.204