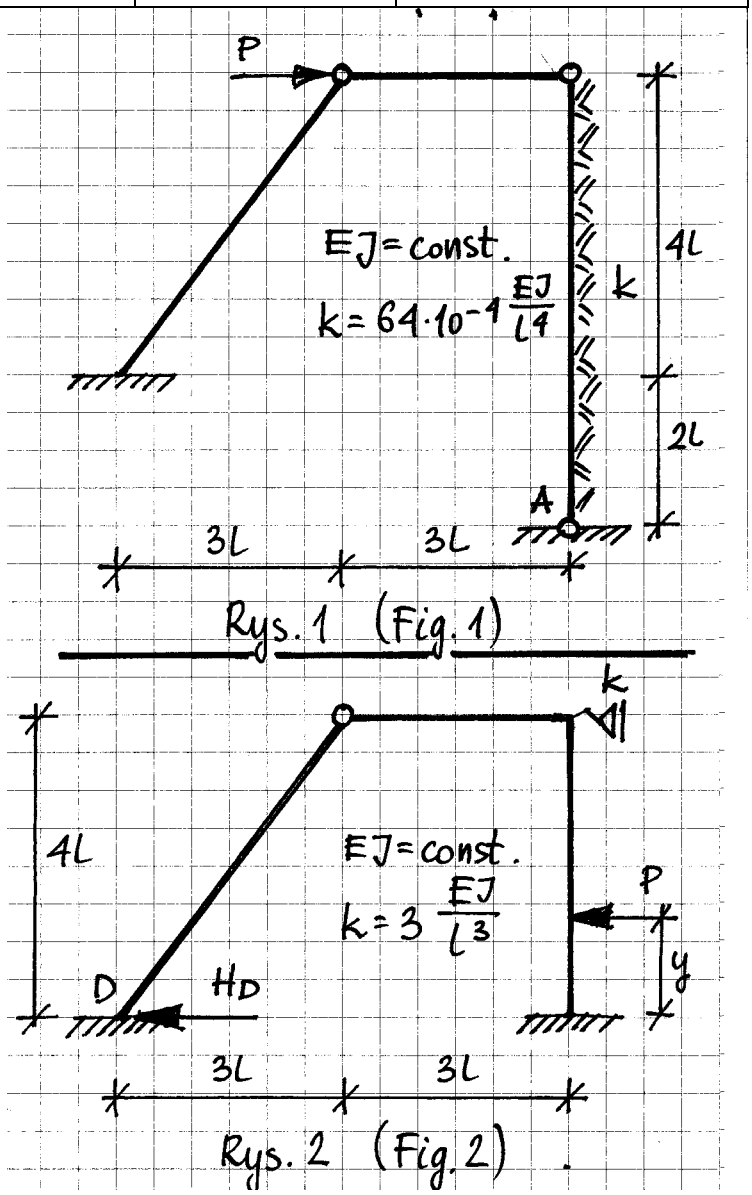
Egzamin z Mechaniki Konstrukcji, 11.09.2015
Exam on the Mechanics of Structures

NAZWISKO, Imię LAST NAME, First Name				
ocena zadania 1	ocena zadania 2	ocena zadania 3	ocena egzaminu	ocena łączna

Zadanie 1 (Rys. 1) **Problem #1 (Fig. 1)**
Oblicz siłę podłużną w pręcie ukośnym.
Calculate the normal internal force in the inclined bar.

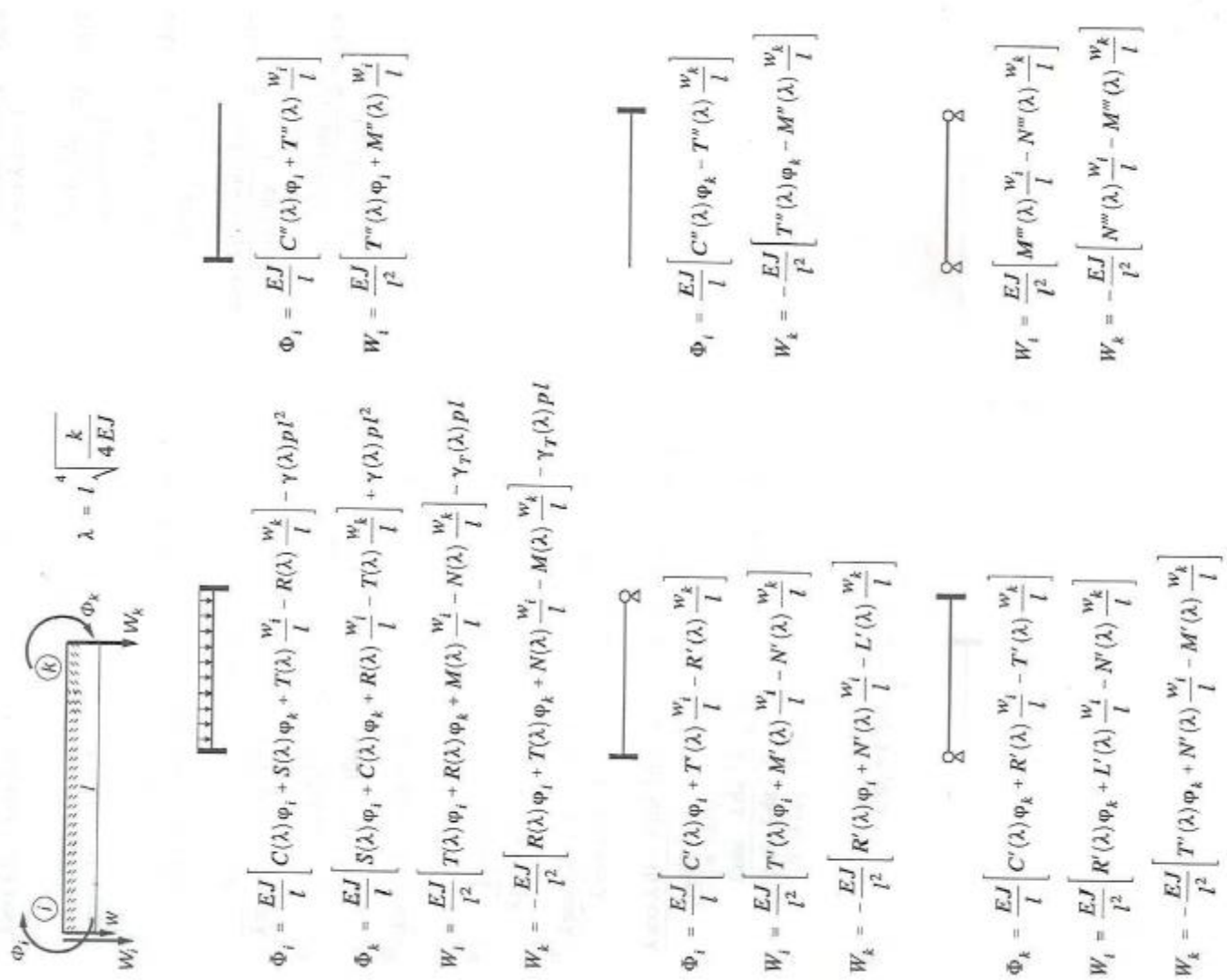
Zadanie 2 (Rys. 1) **Problem #2 (Fig. 1)**
Oblicz wartość kąta obrotu φ_A.
Calculate the rotation angle φ_A.

Zadanie 3 (Rys. 2) **Problem #3 (Fig. 2)**
Wyznacz położenie siły P tak, aby wartość bezwzględna $|H_D|$ była największa.
Find the position of force P for which the absolute value $|H_D|$ is maximal.

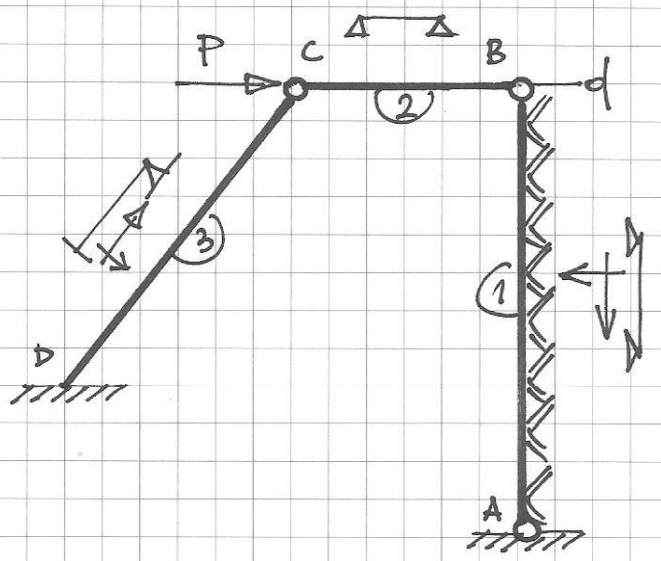


λ	C(λ)	S(λ)	T(λ)	R(λ)	M(λ)	N(λ)	C'(λ)	T'(λ)	R'(λ)
0,0	**4,000**	**2,000**	**6,000**	**6,000**	**12,000**	**12,000**	**3,000**	**3,000**	**3,000**
0,1	4,000	2,000	6,000	6,000	12,000	12,000	3,000	3,000	3,000
0,2	4,000	2,000	6,000	6,000	12,002	11,999	3,000	3,001	3,000
0,3	4,000	2,000	6,002	5,999	12,012	11,996	3,001	3,003	2,999
0,4	4,001	1,999	6,005	5,997	12,038	11,987	3,002	3,009	2,996
0,5	**4,002**	**1,998**	**6,013**	**5,992**	**12,093**	**11,968**	**3,005**	**3,021**	**2,990**
0,6	4,005	1,996	6,027	5,984	12,192	11,933	3,010	3,044	2,980
0,7	4,009	1,993	6,050	5,970	12,356	11,877	3,018	3,082	2,962
0,8	4,016	1,988	6,086	5,949	12,608	11,790	3,031	3,140	2,936
0,9	4,025	1,981	6,137	5,919	12,972	11,665	3,050	3,223	2,898
1,0	**4,038**	**1,972**	**6,208**	**5,877**	**13,480**	**11,491**	**3,075**	**3,338**	**2,846**
1,1	4,055	1,959	6,304	5,821	14,163	11,258	3,109	3,492	2,776
1,2	4,078	1,942	6,429	5,748	15,056	10,956	3,153	3,692	2,687
1,3	4,107	1,920	6,589	5,656	16,197	10,573	3,209	3,944	2,575
1,4	4,143	1,894	6,787	5,541	17,624	10,100	3,277	4,254	2,438
1,5	**4,186**	**1,862**	**7,030**	**5,402**	**19,377**	**9,526**	**3,359**	**4,629**	**2,275**
1,6	4,239	1,823	7,323	5,236	21,498	8,844	3,455	5,071	2,086
1,7	4,301	1,778	7,670	5,041	24,026	8,049	3,566	5,586	1,871
1,8	4,373	1,726	8,075	4,818	27,000	7,136	3,693	6,174	1,632
1,9	4,456	1,666	8,541	4,564	30,459	6,106	3,833	6,835	1,370
2,0	**4,550**	**1,600**	**9,073**	**4,280**	**34,438**	**4,962**	**3,988**	**7,568**	**1,091**

λ	M'(λ)	N'(λ)	L'(λ)	C''(λ)	T''(λ)	M''(λ)	M'''(λ)	N'''(λ)
0,0	**3,000**	**3,000**	**3,000**	**0,000**	**0,000**	**0,000**	**0,000**	**0,000**
0,1	3,000	3,000	3,000	0,000	0,000	0,000	0,000	0,000
0,2	3,003	2,999	3,002	0,002	0,003	0,006	0,002	-0,001
0,3	3,016	2,995	3,008	0,011	0,016	0,032	0,011	-0,005
0,4	3,050	2,986	3,024	0,034	0,051	0,102	0,034	-0,017
0,5	**3,121**	**2,965**	**3,059**	**0,082**	**0,123**	**0,247**	**0,083**	**-0,042**
0,6	3,251	2,928	3,122	0,166	0,250	0,505	0,172	-0,086
0,7	3,465	2,867	3,226	0,298	0,449	0,918	0,318	-0,158
0,8	3,793	2,774	3,385	0,484	0,734	1,520	0,541	-0,268
0,9	4,267	2,639	3,615	0,726	1,107	2,340	0,861	-0,424
1,0	**4,925**	**2,454**	**3,934**	**1,017**	**1,563**	**3,394**	**1,301**	**-0,635**
1,1	5,807	2,209	4,363	1,342	2,087	4,688	1,884	-0,910
1,2	6,954	1,893	4,920	1,686	2,658	6,225	2,630	-1,253
1,3	8,408	1,500	5,626	2,031	3,258	8,008	3,560	-1,665
1,4	10,213	1,021	6,503	2,363	3,871	10,052	4,689	-2,144
1,5	**12,408**	**0,455**	**7,571**	**2,675**	**4,492**	**12,380**	**6,029**	**-2,681**
1,6	15,031	-0,200	8,847	2,963	5,119	15,027	7,587	-3,263
1,7	18,117	-0,941	10,350	3,228	5,756	18,031	9,368	-3,872
1,8	21,694	-1,759	12,093	3,472	6,411	21,438	11,372	-4,487
1,9	25,786	-2,642	14,088	3,700	7,092	25,290	13,599	-5,085
2,0	**30,412**	**-3,573**	**16,347**	**3,915**	**7,807**	**29,631**	**16,049**	**-5,642**

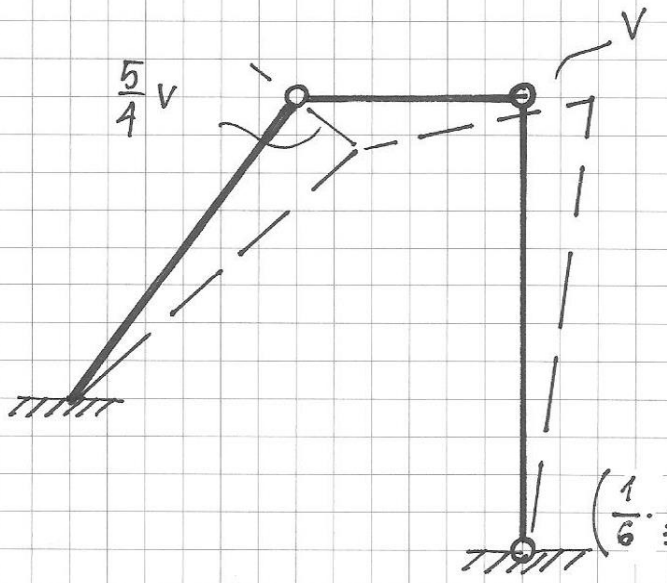


Egzamin z MK IPB, 14.09.2015, zadanie 1



$$q = \left[\frac{V}{l}\right]$$

$$\lambda = 0{,}2$$



$$-W_B^{(1)} \cdot \bar{V} + W_C^{(3)} \cdot \frac{5}{4}\bar{V} = P\bar{V}$$

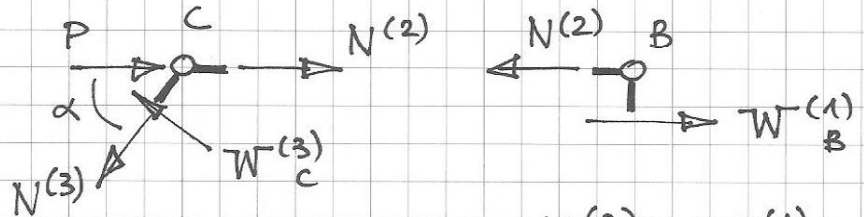
$$-W_B^{(1)} + \frac{5}{4} W_C^{(3)} = P$$

$$W_B^{(1)} = \frac{EJ}{36l^2}\left[-M^{III}(1,2)\,\frac{V}{6l}\right]$$

$$W_C^{(3)} = -\frac{3EJ}{25l^2}\left[-\frac{1}{5l}\cdot\frac{5}{4}V\right]$$

$$\left(\frac{1}{6}\cdot\frac{1}{36}\cdot 2{,}630 + \frac{5}{4}\cdot\frac{3}{25}\cdot\frac{1}{4}\right)\frac{V}{l} = \frac{Pl^2}{EJ}$$

$$\frac{V}{l} = 20{,}13\,\frac{Pl^2}{EJ}$$



$$N^{(2)} = W_B^{(1)}$$

$$N^{(3)} - P\cos\alpha - N^{(2)}\cos\alpha = 0$$

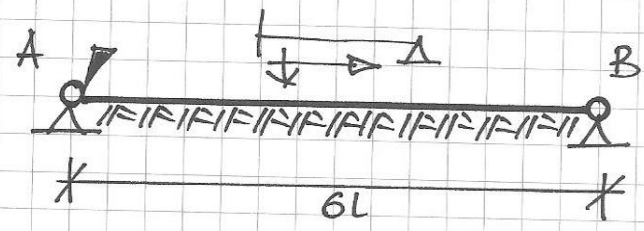
$$N^{(3)} = \left(P + W_B^{(1)}\right)\cos\alpha = \frac{3}{5}\left(P + W_B^{(1)}\right)$$

$$W_B^{(1)} = -0{,}245\,P \;\rightarrow\; N^{(3)} = 0{,}453\,P$$

opracował: G. Dzierżanowski

Egzamin z MK IPB, 11.09.2015, zadanie 2

Korzystamy z rozwiązania zadania 1.
We make use of the solution to the problem #1.



$$V = 20{,}13\,\frac{PL^3}{EJ}$$

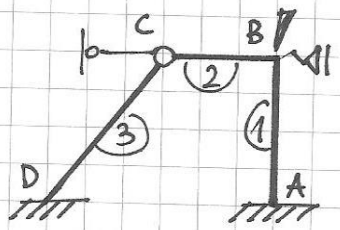
$$\Phi_A = 0$$

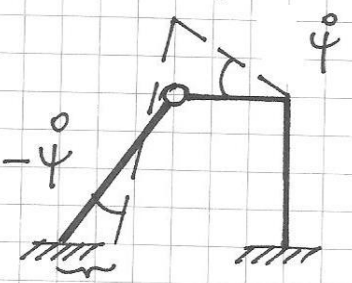
$$\frac{EJ}{6L}\left[c^1(1,2)\varphi_A\right] + \frac{EJ}{6L}\left[-R^1(1,2)\cdot\frac{V}{6L}\right] = 0$$

$$\varphi_A = \frac{1}{6}\cdot\frac{R^1(1,2)}{c^1(1,2)}\,\frac{V}{L} = 2{,}859\,\frac{PL^2}{EJ}$$

opracował: G. Dzierżanowski

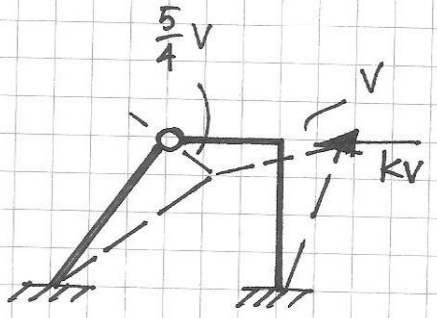
Egzamin z MK IPB, 11.09.2015, zadanie 3





$$\dot\psi = \frac{1}{4L}$$

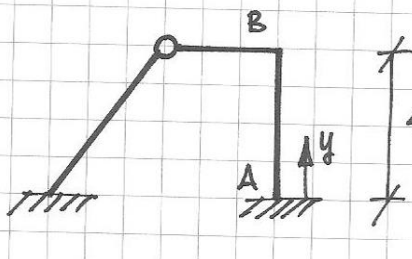
$$\tau = 3$$



$$q = \left[\varphi_B \quad \frac{V}{L}\right]^T$$

$$\begin{cases} \Phi_B^{(1)} + \Phi_B^{(2)} = 0 \\ \left[\Phi_A^{(1)} + \Phi_B^{(1)}\right]\cdot\frac{\bar V}{4L} + \Phi_B^{(2)}\cdot\left(-\frac{\bar V}{4L}\right) \\ \quad + \Phi_D^{(3)}\cdot\frac{\bar V}{4L} - kV\bar V = 0 \end{cases}$$

$$\varphi_B = 0{,}128\cdot\frac{1}{L} \qquad \frac{V}{L} = 0{,}043\cdot\frac{1}{L}$$



$$w_{AB}(y) = C_0 + C_1 y + C_2 y^2 + C_3 y^3$$

$$w_{AB}(0) = 0 \qquad w_{AB}(4L) = 0{,}043$$

$$w'_{AB}(0) = 0 \qquad w'_{AB}(4L) = 0{,}128\cdot\frac{1}{L}$$

$$w_{AB}(y) = -0{,}0239\left(\frac{y}{L}\right)^2 + 0{,}0066\cdot\left(\frac{y}{L}\right)^3$$

$$y \in [0, 4L]$$

Na mocy tw. Bettiego: $H_D(y) = P\cdot w_{AB}(y) \rightarrow \max_y |H_D(y)| \rightarrow y_* = 2{,}398L$