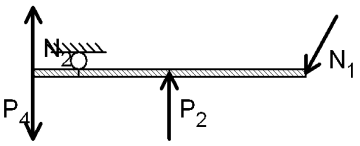
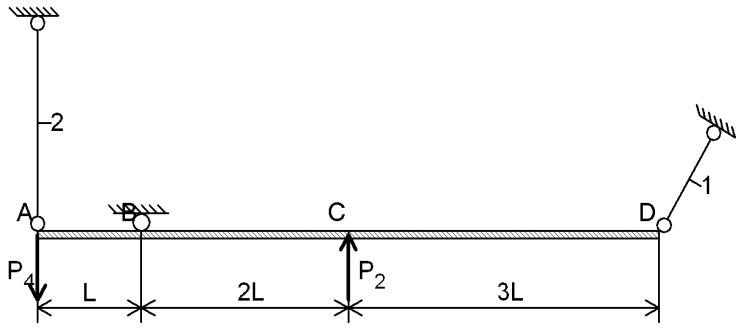
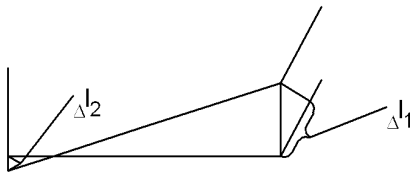
Задача 1.4







Дано:
$P_2 = 2P$; $P_4 = 4P$;

$l_1 = 1{,}15L$; $l_2 = 2L$; $F_1 = F$; $F_2 = F$;

Уравнение равновесия:
$\Sigma M(B) = -N_1 \cdot \sin 60° \cdot 5L - N_2 \cdot L + 2P \cdot 2L + 4P \cdot L = 0$

Уравнение деформаций:

$$\frac{\Delta l_1}{5L \cdot \cos 30°} = \frac{\Delta l_2}{L};$$

$$0{,}231 \cdot \frac{N_1 \cdot 1{,}15L}{EF} = \frac{N_2 \cdot 2L}{EF}$$

$N_2 = 0{,}133N_1$;
$4{,}33N_1 + 0{,}133N_1 = -8P$
$4{,}46N_1 = -8P$; $N_1 = 1{,}79P$
$N_2 = 0{,}239P$;

$$\sigma_1 = \frac{1{,}79P}{F} = 1{,}79\frac{P}{F}; \quad \sigma_2 = \frac{0{,}239P}{F} = 0{,}239\frac{P}{F};$$

$$\sigma_{max} = \sigma_1 = 1{,}79\frac{P}{F}$$

$\sigma_т = 300$ МПа

$$P_т = \frac{300 \cdot 10^6 \cdot 1 \cdot 10^{-4}}{1{,}79} = 16{,}7 \text{ кН}$$

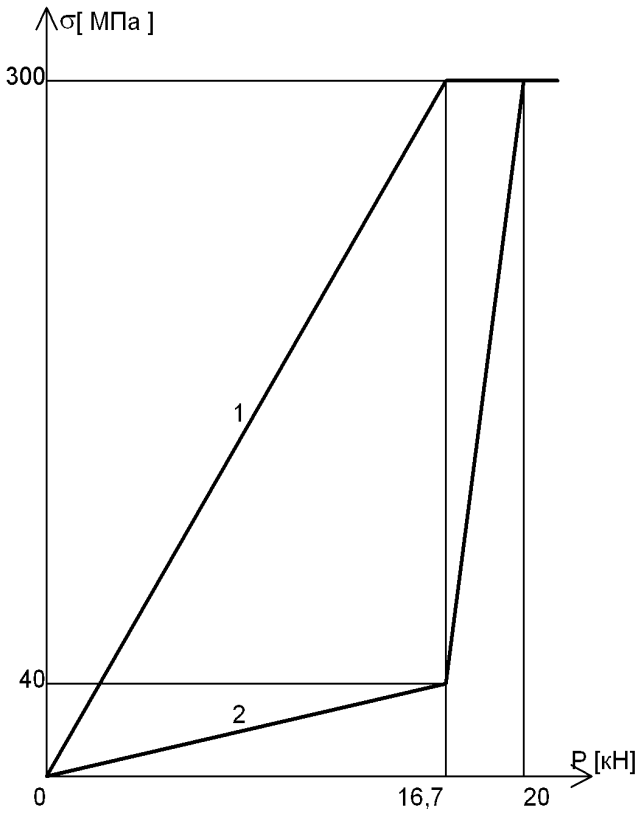
$N_{1т} = \sigma_т \cdot F_1 = 30$ кН ; $N_{2т} = \sigma_т \cdot F_2 = 30$ кН

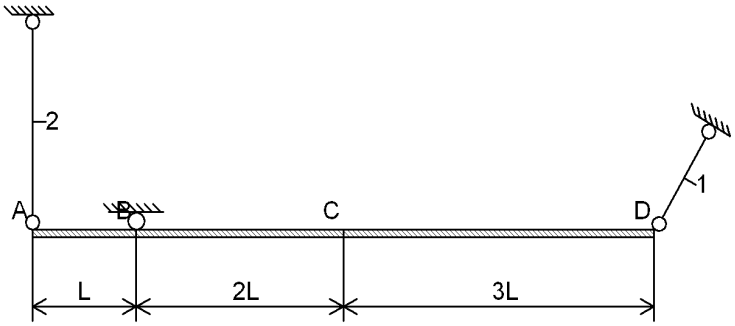
$P_{пред} = 0{,}541 N_{1т} + 0{,}125 N_{2т} = 0{,}541 \cdot 30 + 0{,}125 \cdot 30 = 20$ кН

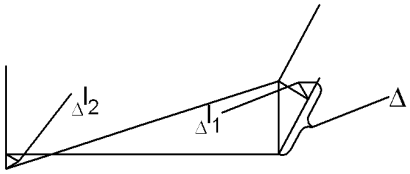
При $P = P_т$:
$\sigma_1 = 1{,}79 \cdot 16{,}7 \cdot 10 = 300$МПа ; $\sigma_2 = 0{,}239 \cdot 16{,}7 \cdot 10 = 40$МПа ;

При $P = P_{пред}$:

$\sigma_1 = 300$МПа ; $\sigma_2 = 300$МПа ;







Дано:
$\Delta = 1$ мм

$l_1 = 1{,}15L$; $l_2 = 2L$; $F_1 = F$; $F_2 = F$;

Уравнение равновесия:
$\Sigma M(B) = N_1 \cdot \sin 60° \cdot 5L - N_2 \cdot L = 0$

Уравнение деформаций:

$$\frac{\Delta - {}_{\Delta}l_1}{5L \cdot \cos 30°} = \frac{{}_{\Delta}l_2}{L};$$

$${}_{\Delta}l_1 + 4{,}33\,{}_{\Delta}l_2 = \Delta;$$

$$\frac{N_1 \cdot 1{,}15L}{EF} + 4{,}33\frac{N_2 \cdot 2L}{EF} = \Delta$$

$$1{,}15N_1 + 8{,}66N_2 = \frac{\Delta EF}{L}$$

$N_2 = 4{,}33N_1$

$$1{,}15N_1 + 8{,}66 \cdot 4{,}33N_1 = \frac{\Delta EF}{L};\ 38{,}7N_1 = \frac{\Delta EF}{L}$$

$$N_1 = 0{,}026\,\frac{\Delta EF}{L};\ N_2 = 0{,}112\,\frac{\Delta EF}{L};$$

$N_1 = 0{,}517\text{кН}$; $N_2 = 2{,}24\text{кН}$;

$\sigma_1 = \frac{0{,}517 \cdot 10^3}{1 \cdot 10^{-4}} = 5{,}17\text{МПа}$; $\sigma_2 = \frac{2{,}24 \cdot 10^3}{1 \cdot 10^{-4}} = 22{,}4\text{МПа}$;