Problem 3

Reduce the block diagram shown in figure 3 to a single transfer function, $G(s) = \frac{Y(s)}{U(s)}$. Assume that $P_1 = 6$, $P_2 = 21$, $R_1 = 7$ and $R_2 = 18$.

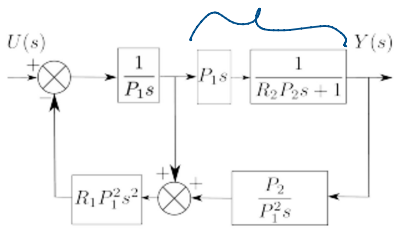
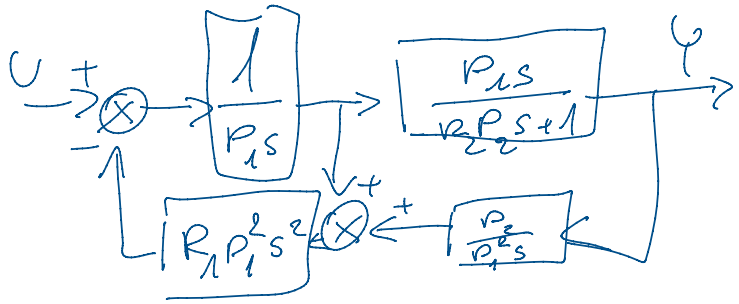
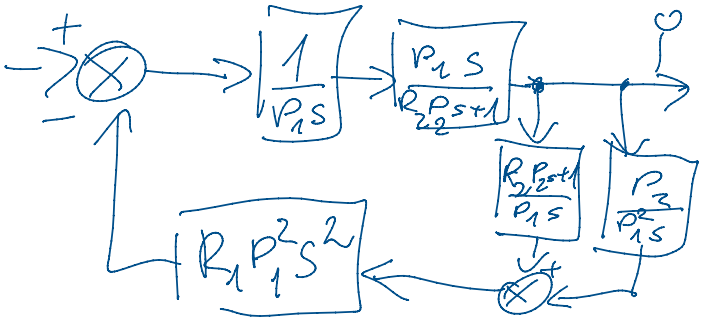
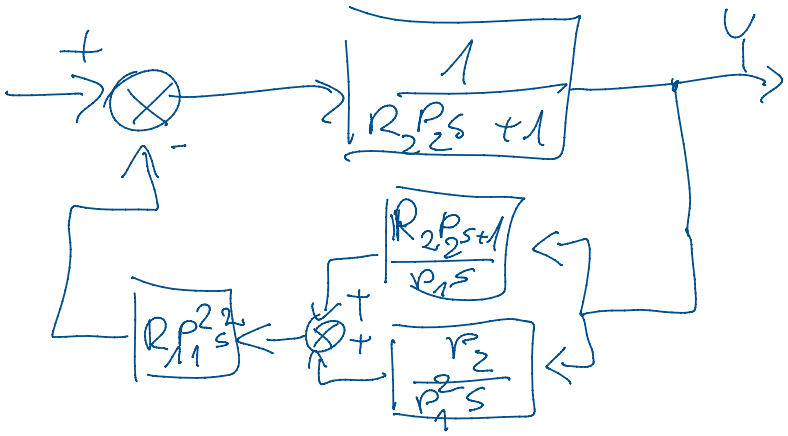


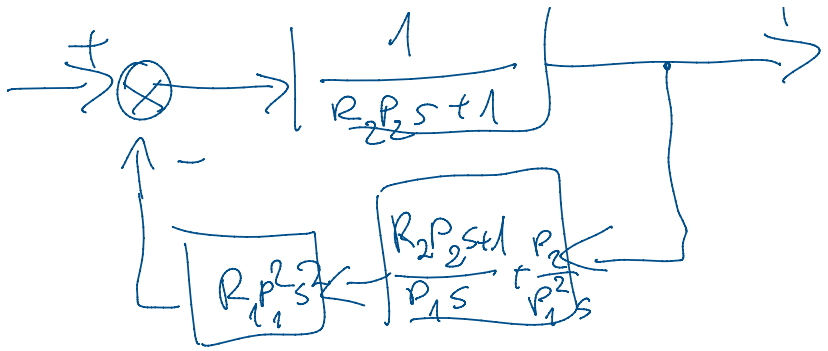
Figure 3: *Block diagram*

Answer: $G(s) =$ _____



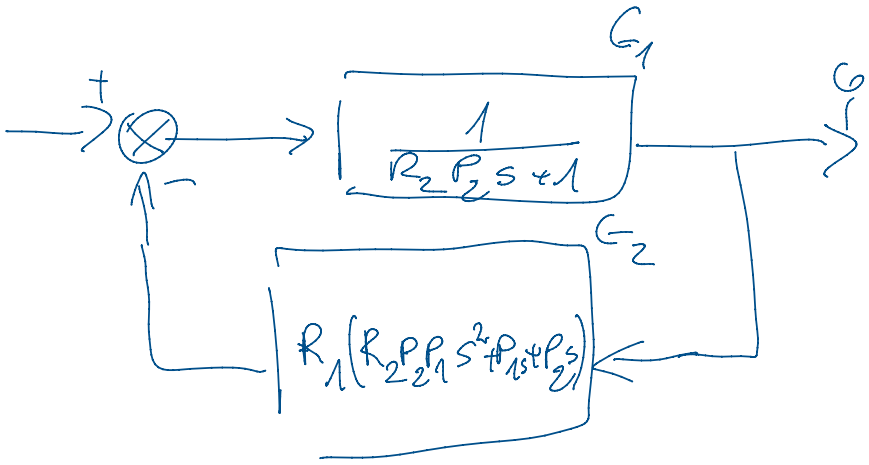


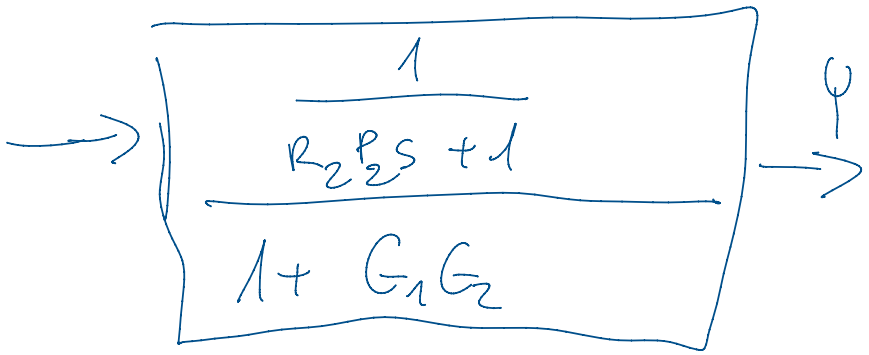




$$\frac{R_2P_2s+1}{P_1s} + \frac{P_2}{P_1^2s} = \frac{R_2P_2P_1s + P_1 + P_2}{P_1^2s} \quad / \cdot R_1P_1^2s^2$$

$$R_2R_1P_2P_1s^2 + R_1P_1s + R_1P_2s$$





$$G_1 G_2 = \frac{1}{R_2 P_2 s + 1} \cdot R_1 (R_2 P_2 P_1 s^2 + P_1 s + P_2 s)$$

$$G_1 G_2 = \frac{R_1 R_2 P_1 P_2 s^2 + P_1 R_1 s + P_2 R_1 s}{R_2 P_2 s + 1} \quad / + 1$$

$$1 + G_1 G_2 = \frac{R_1 R_2 P_1 P_2 s^2 + R_1 P_1 s + P_2 R_1 s}{R_2 P_2 s + 1} + \frac{R_2 P_2 s + 1}{R_2 P_2 s + 1}$$

$$\frac{1}{\cancel{R_2 P_2 s + 1}} \cdot \frac{\cancel{R_2 P_2 s + 1}}{R_1 R_2 P_1 P_2 s^2 + R_1 P_1 s + P_2 R_1 s + R_2 P_2 s + 1}$$

$$G(s) = \frac{1}{(\quad \cdot \quad \cdot \quad)}$$

$$G(s) = \frac{}{s^2(R_1P_1R_2P_2) + s(R_1P_1 + R_1P_2 + R_2P_2) + 1}$$

$P_1 = 6, P_2 = 21, R_1 = 7$ $R_2 = 18$

$$A_{\delta^2} = 18 \cdot 7 \cdot 21 \cdot 6 = 15\,876$$

$$B_\delta = 42 + 147 + 378 = 567$$

$$C_{\delta 0} = 1$$

$$G(s) = \frac{1}{15876\,s^2 + 567\,s + 1}$$