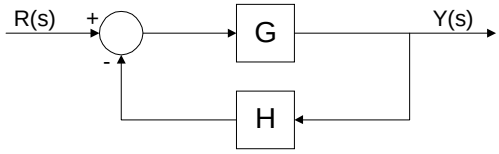
1. a)



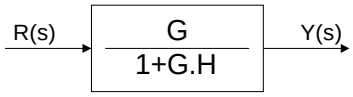
A primeira possibilidade de resolução deste exercício passa pela análise completa das equações representadas no diagrama de blocos. Assim, temos:

$$Y(s) = G.E(s) \Leftrightarrow E(s) = \frac{Y(s)}{G}$$

$$E(s) = R(s) - H.Y(s)$$

$$\frac{Y(s)}{G} = R(s) - H.Y(s) \Leftrightarrow$$
$$\Leftrightarrow R(s) = \frac{Y(s)}{G} + H.Y(s) \Leftrightarrow$$
$$\Leftrightarrow R(s) = \left[\frac{1}{G} + H\right].Y(s) \Leftrightarrow$$
$$\Leftrightarrow \frac{Y(s)}{R(s)} = \frac{G}{1+G.H}$$

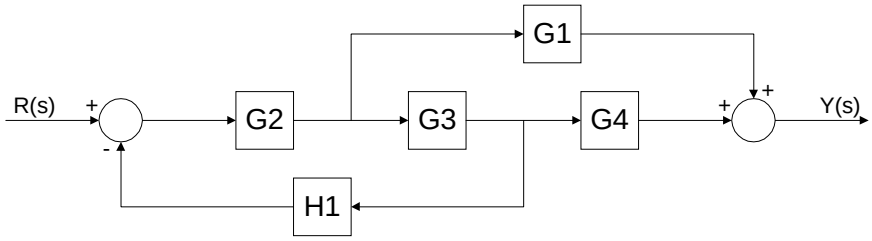
Alternativamente, aplicando as regras da álgebra de blocos, temos:



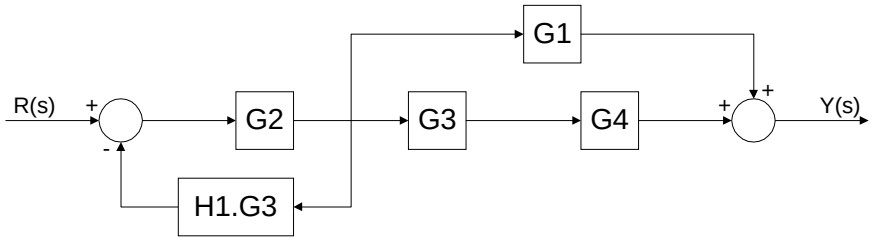
ou seja:

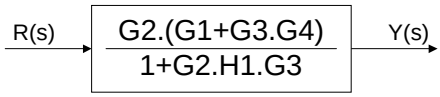
$$\frac{Y(s)}{R(s)} = \frac{G}{1+G.H}$$

1. b)



Aplicando as regras da álgebra de blocos, temos:

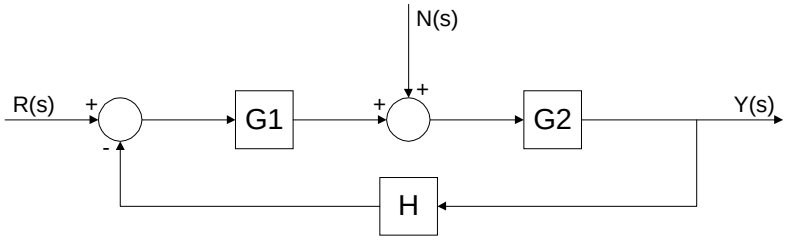




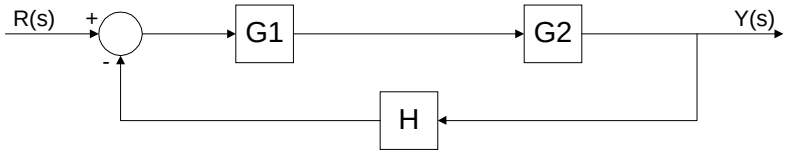
Verifica-se que a Função de Transferência deste sistema é:

$$\frac{Y(s)}{R(s)} = \frac{G2.(G1 + G3.G4)}{1 + G2.H1.G3}$$

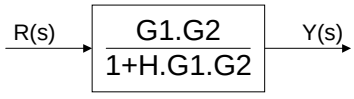
1. c)



Uma vez que este sistema apresenta duas entradas distintas, R(s) e N(s), devemos aplicar o Teorema da Sobreposição. Assim, considerando N(s)=0, ficamos com o seguinte diagrama de blocos equivalente:



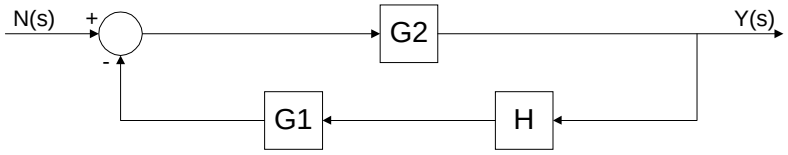
Aplicando as regras da álgebra de blocos, temos:



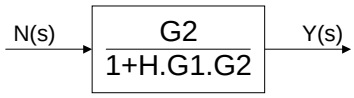
Logo:

$$\frac{Y(s)}{R(s)} = \frac{G1.G2}{1 + G1.G2.H}$$

Considerando agora R(s)=0, ficamos com o seguinte diagrama de blocos equivalente:



Aplicando as regras da álgebra de blocos, temos:



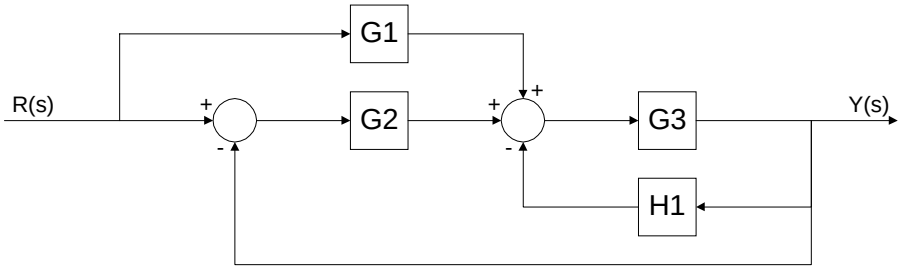
Logo:

$$\frac{Y(s)}{N(s)} = \frac{G2}{1+G1.G2.H}$$

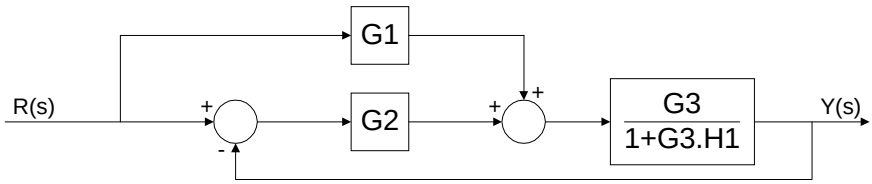
Por aplicação do Teorema da Sobreposição, concluímos que a Função de Transferência deste sistema é:

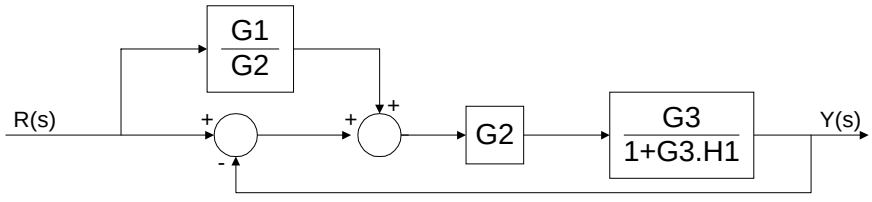
$$Y(s) = \frac{G1.G2}{1+G1.G2.H}.R(s) + \frac{G2}{1+G1.G2.H}.N(s)$$

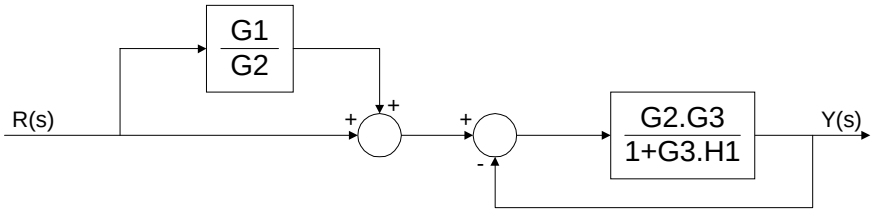
1. d)

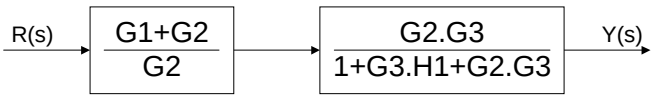


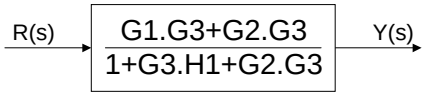
Aplicando as regras da álgebra de blocos, temos:







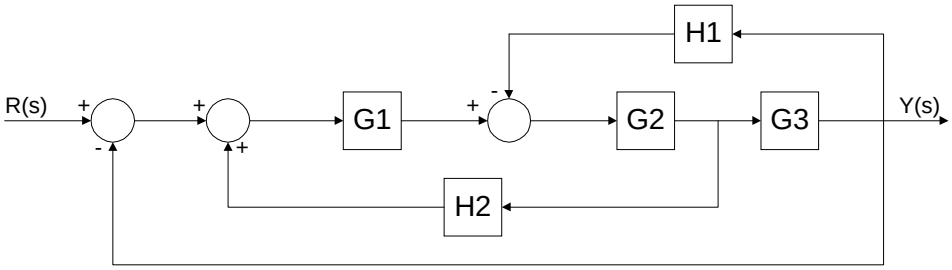




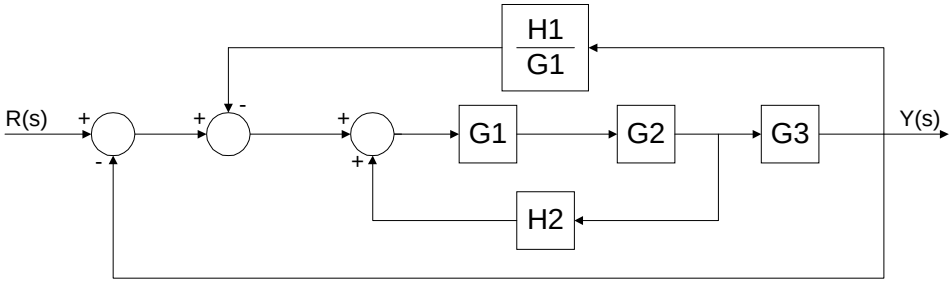
Logo:

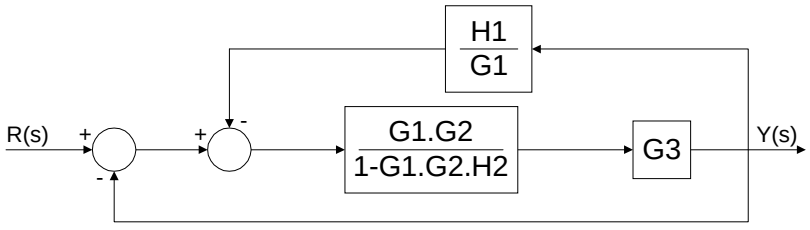
$$\frac{Y(s)}{R(s)} = \frac{G1.G3 + G2.G3}{1 + G3.H1 + G2.G3}$$

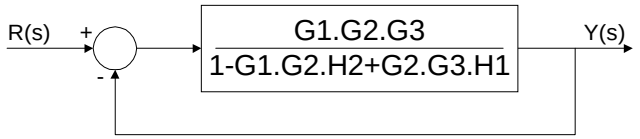
1. e)

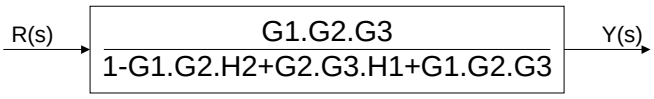


Aplicando as regras da álgebra de blocos, temos:





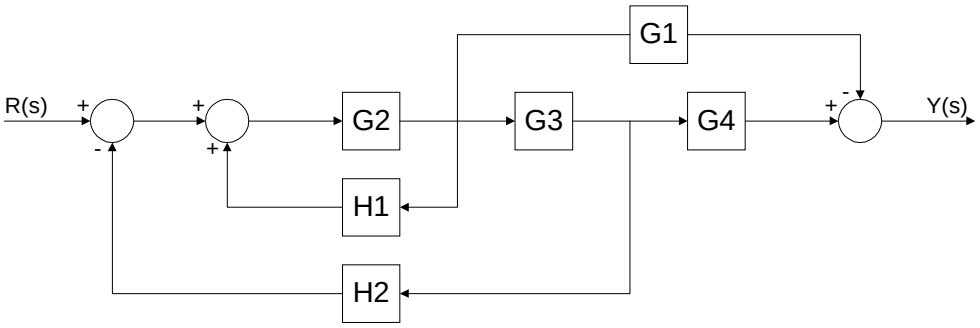




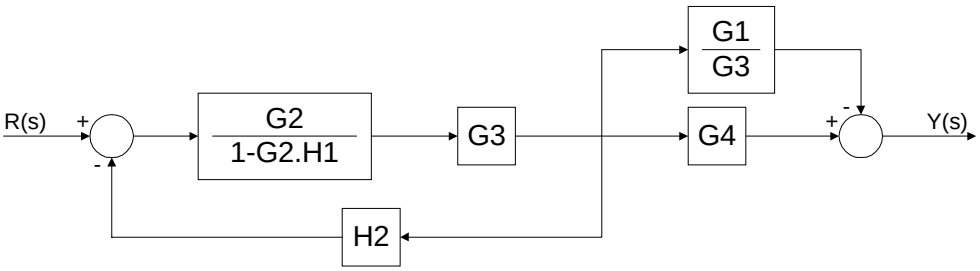
Logo:

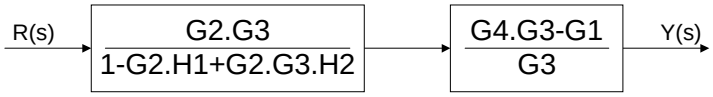
$$\frac{Y(s)}{R(s)} = \frac{G1.G2.G3}{1 - G1.G2.H2 + G2.G3.H1 + G1.G2.G3}$$

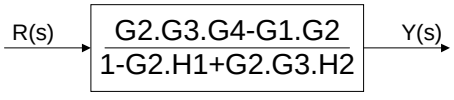
1. f)



Aplicando as regras da álgebra de blocos, temos:



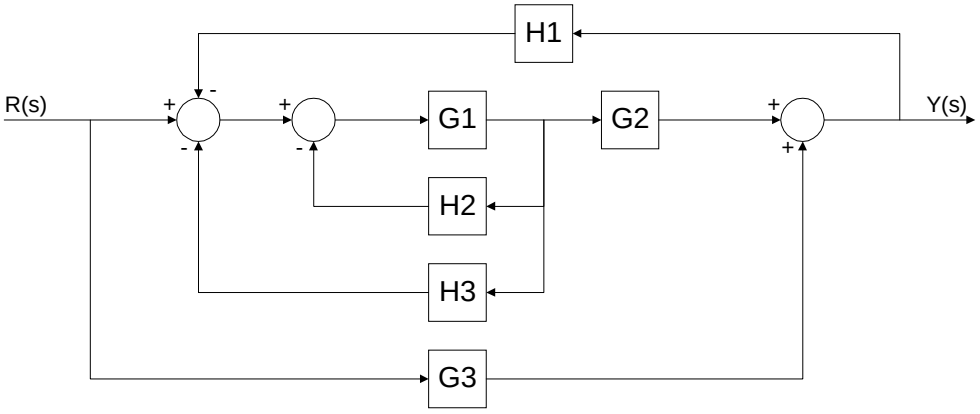




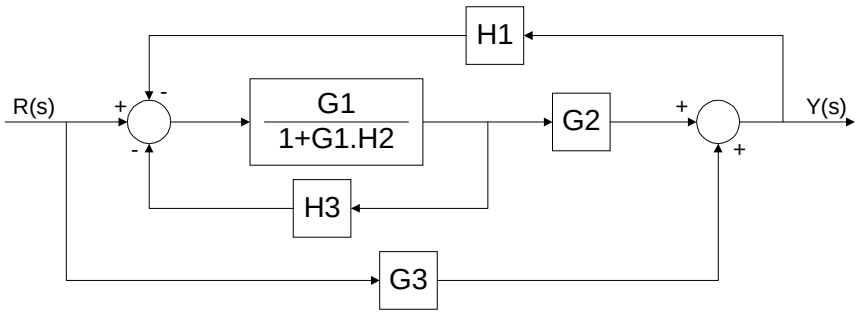
Logo:

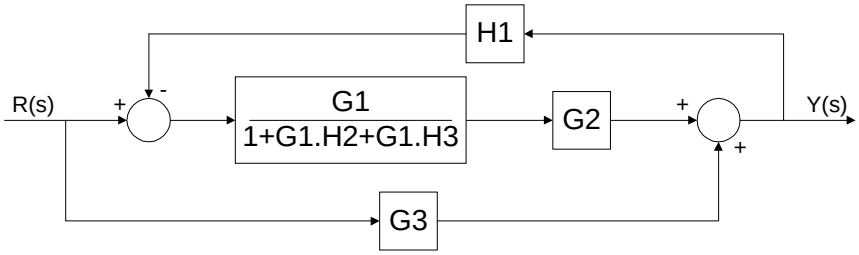
$$\frac{Y(s)}{R(s)} = \frac{G2.G3.G4 - G1.G2}{1 - G2.H1 + G2.G3.H2}$$

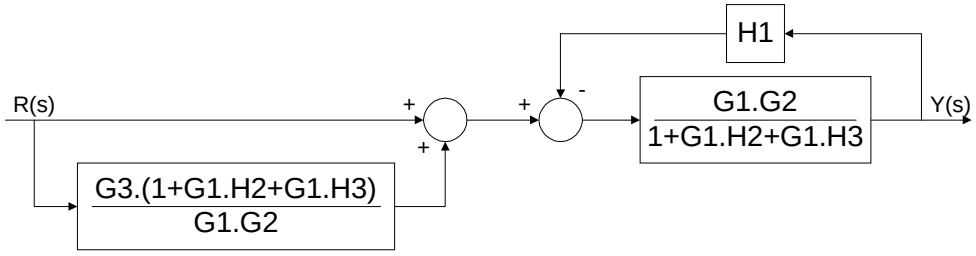
1. g)

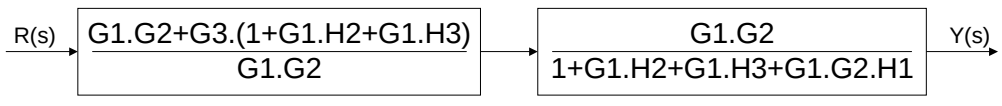


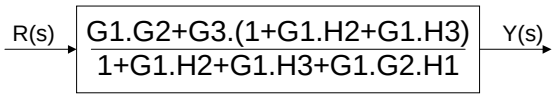
Aplicando as regras da álgebra de blocos, temos:







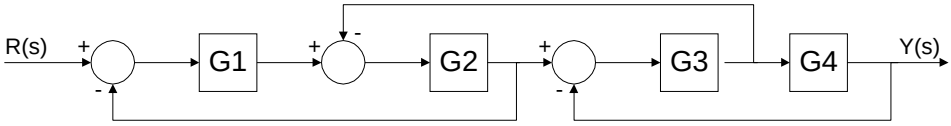




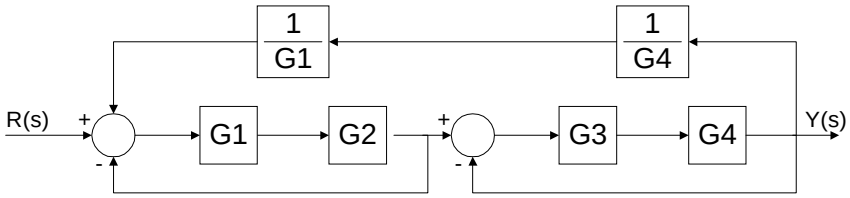
Logo:

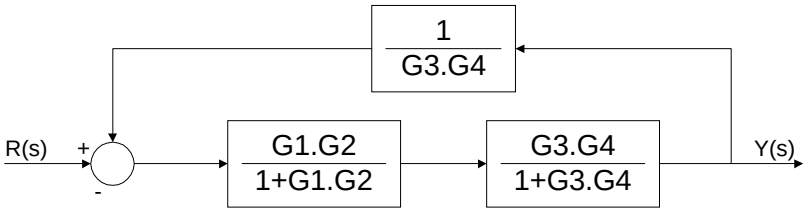
$$\frac{Y(s)}{R(s)} = \frac{G1.G2 + G3.(1 + G1.H2 + G1.H3)}{1 + G1.H2 + G1.H3 + G1.G2.H1}$$

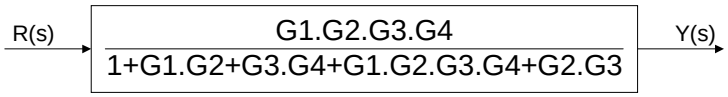
1. h)



Aplicando as regras da álgebra de blocos, temos:



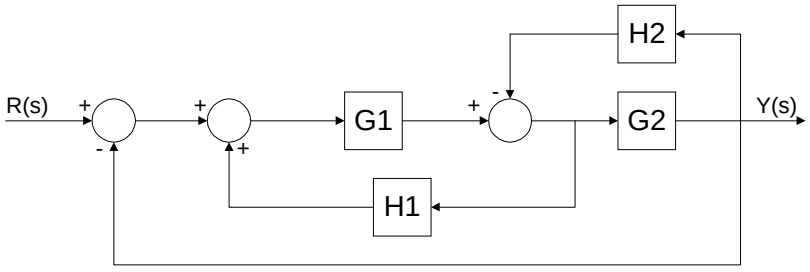




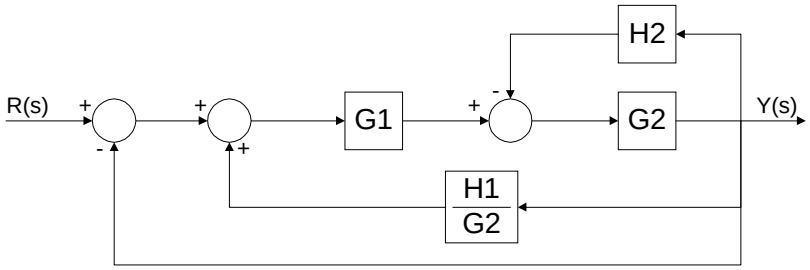
Logo:

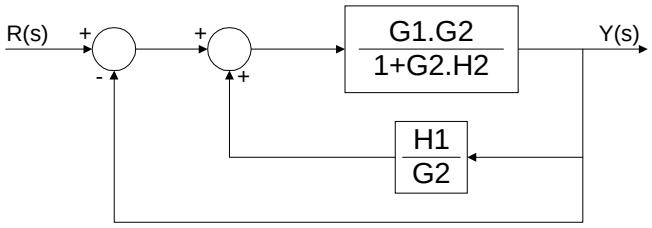
$$\frac{Y(s)}{R(s)} = \frac{G1.G2.G3.G4}{1 + G1.G2 + G3.G4 + G2.G3 + G1.G2.G3.G4}$$

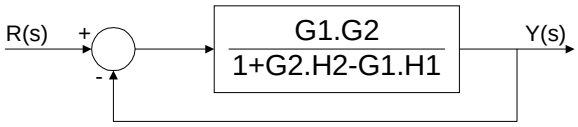
1. i)

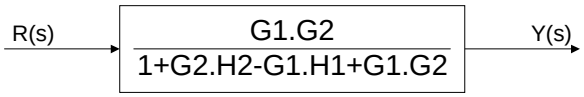


Aplicando as regras da álgebra de blocos, temos:





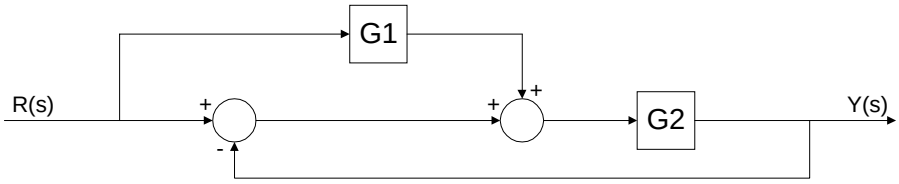




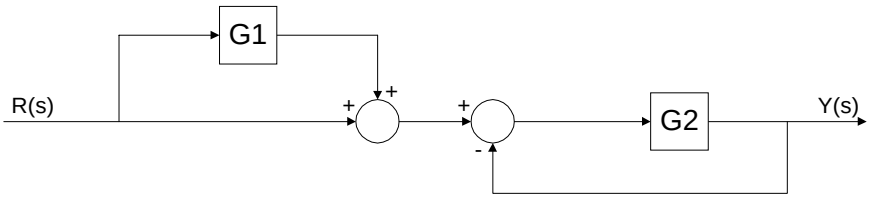
Logo:

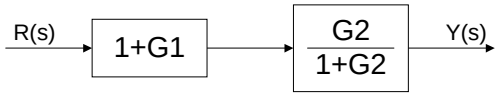
$$\frac{Y(s)}{R(s)} = \frac{G1.G2}{1+G2.H2-G1.H1+G1.G2}$$

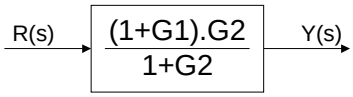
1. j)



Aplicando as regras da álgebra de blocos, temos:



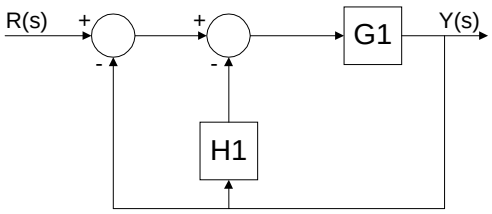




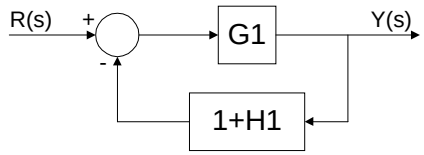
Logo:

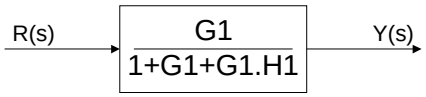
$$\frac{Y(s)}{R(s)} = \frac{(1+G1).G2}{1+G2}$$

1. k)



Aplicando as regras da álgebra de blocos, temos:

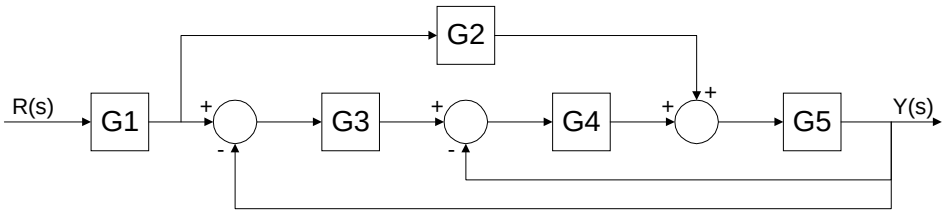




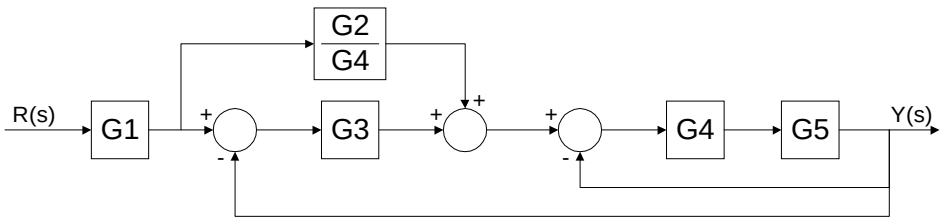
Logo:

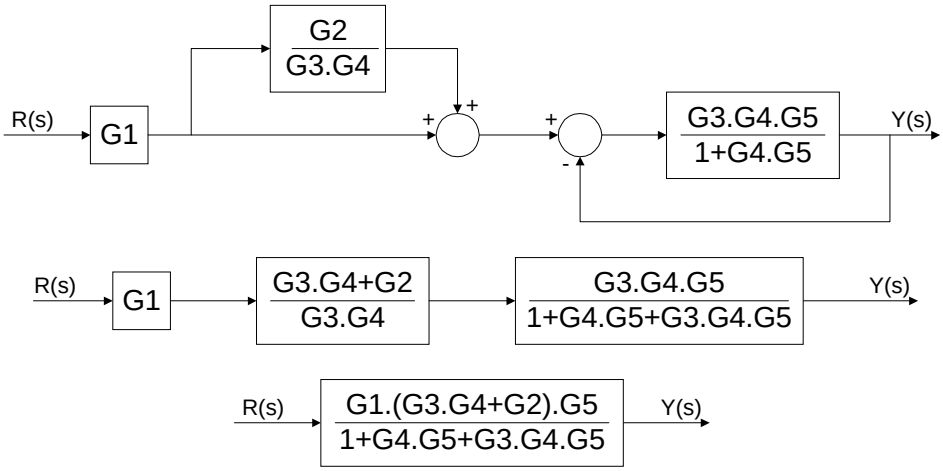
$$\frac{Y(s)}{R(s)} = \frac{G1}{1+G1+G1.H1}$$

1. l)



Aplicando as regras da álgebra de blocos, temos:





Logo:

$$\frac{Y(s)}{R(s)} = \frac{(G3.G4 + G2).G1.G5}{1 + G4.G5 + G3.G4.G5}$$