7 Übungen Bode-Diagramm

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Aufgabe 1: Review-Fragen

1. Warum schlug Bode vor, den Amplitudengang einer Frequenzantwort doppelt-logarithmisch darzustellen?
2. Definieren Sie Dezibel.
3. Was ist die Amplitude der Übertragungsfunktion bei einer Verstärkung von 14 dB

Aufgabe 2: Bode-Diagramm

Skizzieren Sie die Asymptoten des Amplituden- und Phasengangs folgender Übertragungsfunktionen. Verifizieren Sie Ihre Ergebnisse mit Hilfe von MATLAB.

1. [FPE10, Aufgabe 6.3]
   (a) $L(s) = \dfrac{2000}{s(s+200)}$
   (b) $L(s) = \dfrac{100}{s(0.1s+1)(0.5s+1)}$
   (c) $L(s) = \dfrac{1}{s(s+1)(0.02s+1)}$
   (d) $L(s) = \dfrac{1}{(s+1)^2(s^2+2s+4)}$
   (e) $L(s) = \dfrac{10(s+4)}{s(s+1)(s^2+2s+5)}$
   (f) $L(s) = \dfrac{1000(s+0.1)}{s(s+1)(s^2+8s+64)}$
   (g) $L(s) = \dfrac{(s+5)(s+3)}{s(s+1)(s^2+s+4)}$
   (h) $L(s) = \dfrac{4s(s+10)}{(s+100)(4s^2+5s+4)}$
   (i) $L(s) = \dfrac{s}{(s+1)(s+10)(s^2+2s+2500)}$
2. [FPE10, Aufgabe 6.4] Reelle Pole und Nullstellen.
   (a) $L(s) = \dfrac{1}{s(s+1)(s+5)(s+10)}$
   (b) $L(s) = \dfrac{s+2}{s(s+1)(s+5)(s+10)}$
   (c) $L(s) = \dfrac{(s+2)(s+4)}{s(s+1)(s+5)(s+10)}$
   (d) $L(s) = \dfrac{(s+2)(s+6)}{s(s+1)(s+5)(s+10)}$
3. [FPE10, Aufgabe 6.5] Komplexe Pole und Nullstellen. Bestimmen / approximieren Sie den Wert des Amplitudengangs an den Eckfrequenzen der Terme zweiter Ordnung.
   (a) $L(s) = \dfrac{1}{s^2+3s+10}$
   (b) $L(s) = \dfrac{1}{s(s^2+3s+10)}$
   (c) $L(s) = \dfrac{s^2+2s+8}{s(s^2+2s+10)}$
   (d) $L(s) = \dfrac{s^2+2s+12}{s(s^2+2s+10)}$

(e) $L(s) = \dfrac{s^2+1}{s(s^2+4)}$

(f) $L(s) = \dfrac{s^2+4}{s(s^2+1)}$

4. [FPE10, Aufgabe 6.6] Mehrfache Pole im Ursprung.

   (a) $L(s) = \dfrac{1}{s^2(s+8)}$

   (b) $L(s) = \dfrac{1}{s^3(s+8)}$

   (c) $L(s) = \dfrac{1}{s^4(s+8)}$

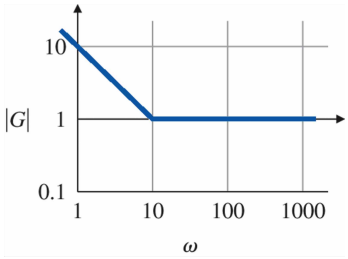
   (d) $L(s) = \dfrac{s+3}{s^2(s+8)}$

   (e) $L(s) = \dfrac{s+3}{s^3(s+4)}$

   (f) $L(s) = \dfrac{(s+1)^2}{s^3(s+4)}$

   (g) $L(s) = \dfrac{(s+1)^2}{s^3(s+10)^2}$

5. [FPE10, Aufgabe 6.9] Bestimmen sie die Übertragungsfunktion für folgendes asymptotisches Bodediagramm:

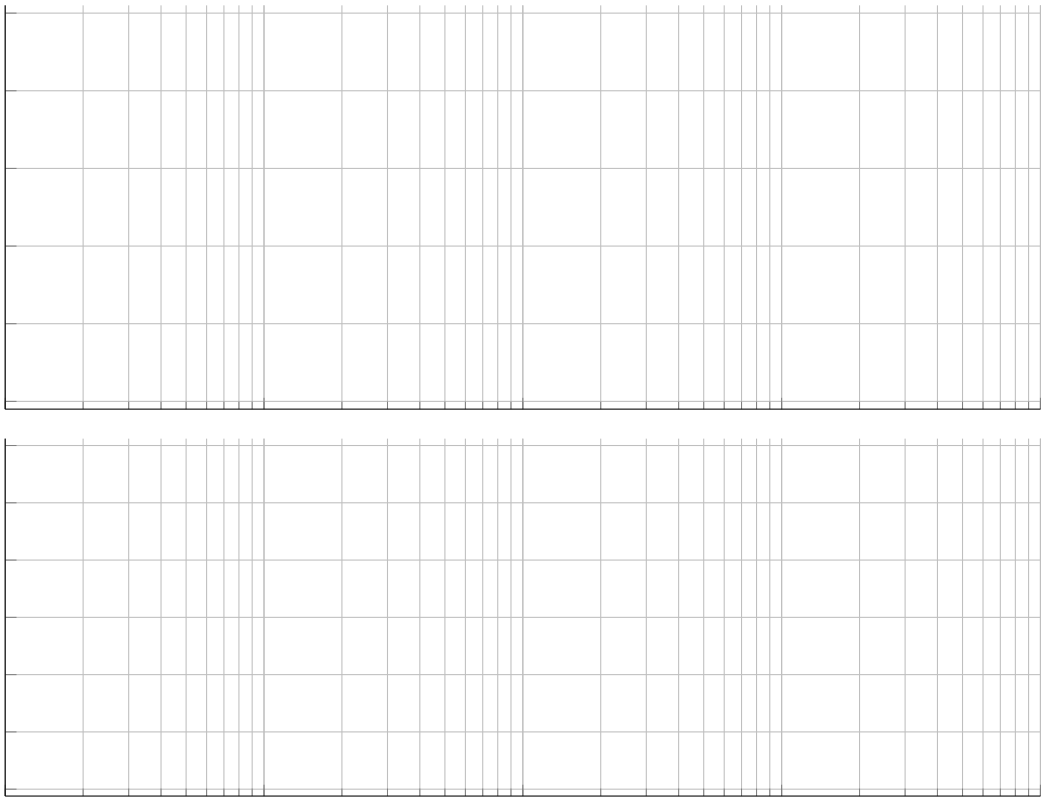


[FPE10, Figure 6.87]

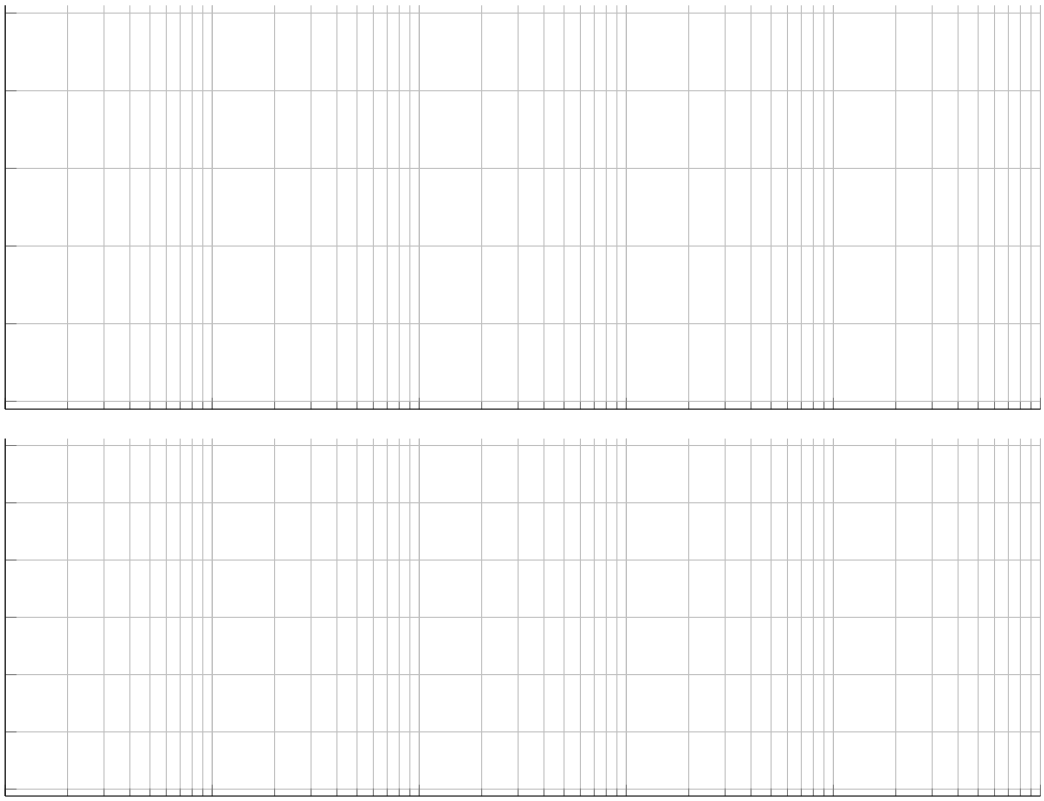
Bestimmen Sie die Sprungantwort des Systems.

1. 1.(a)

1.(b)

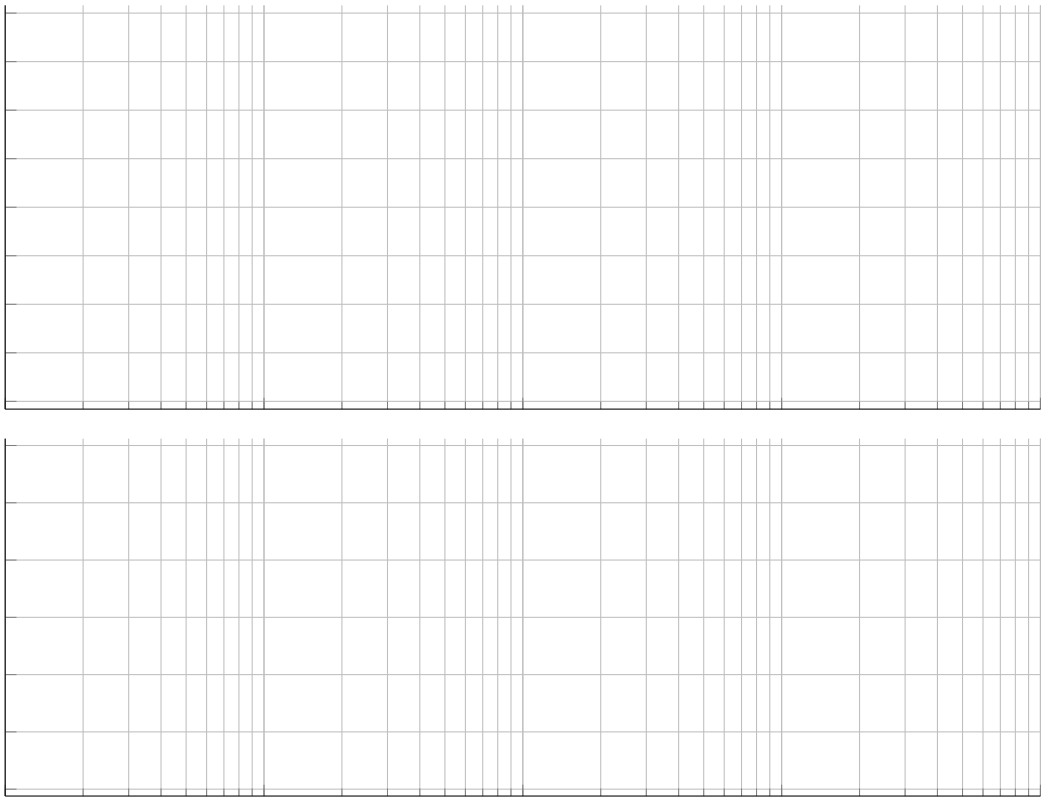


1.(c)

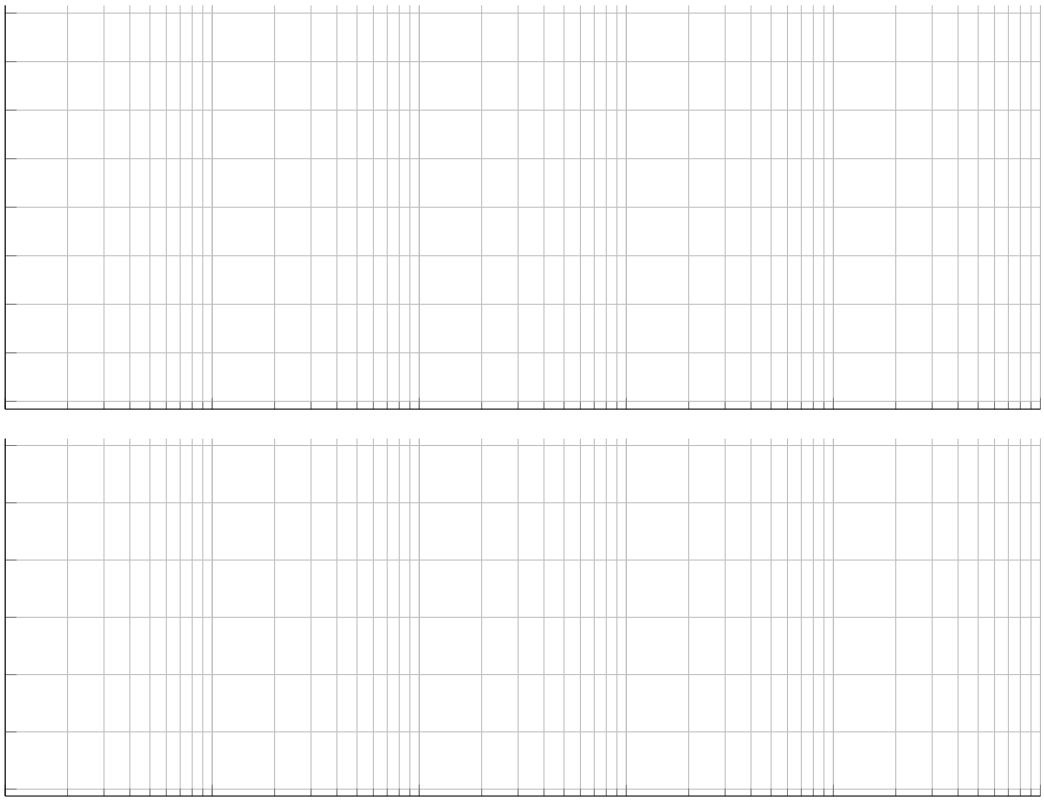


1.(d)

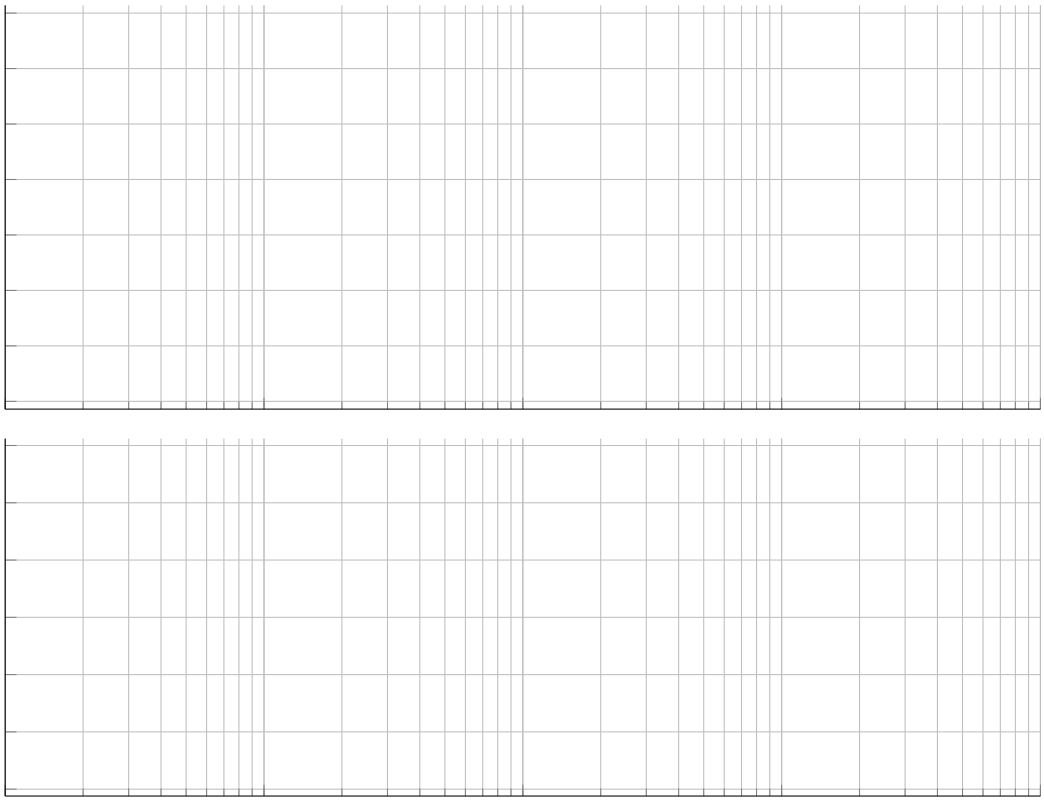
1.(e)



1.(f)

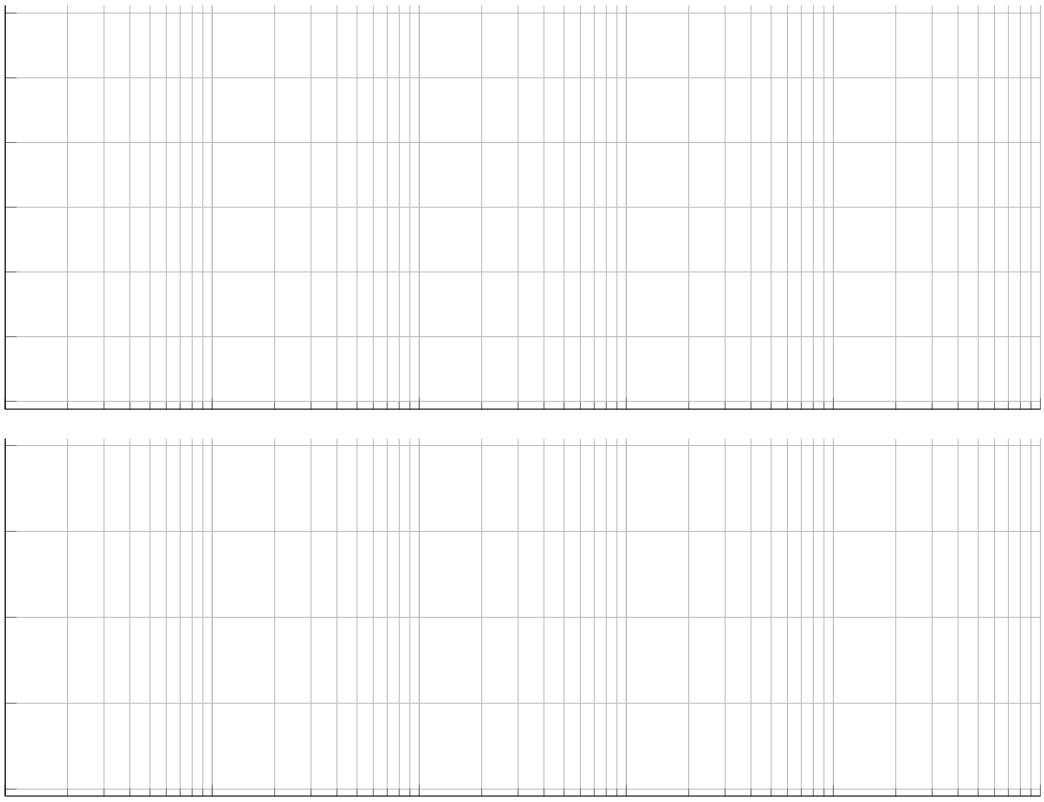


1.(g)

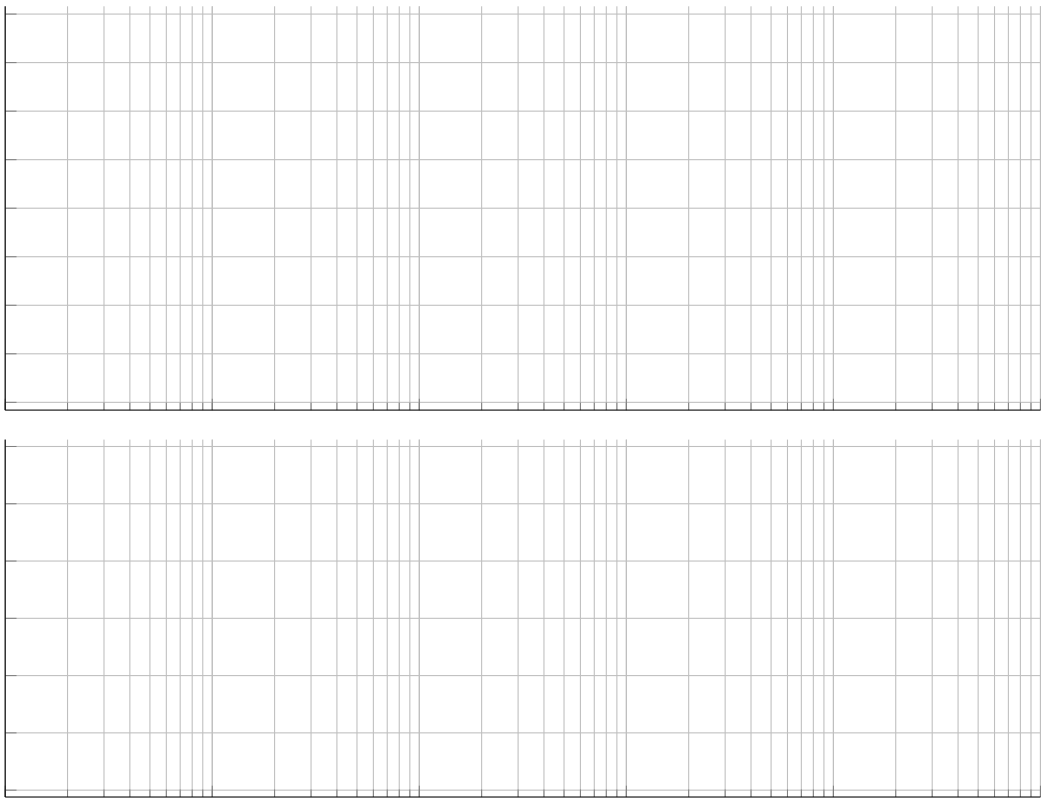


1.(h)

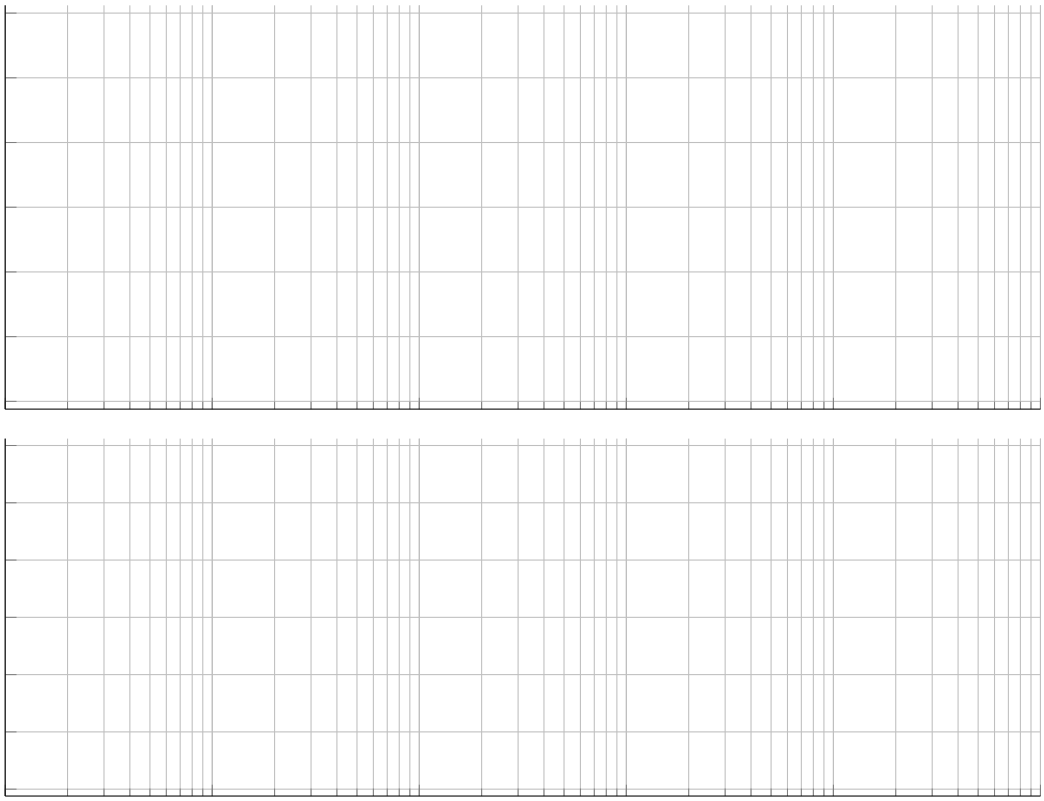
1.(i)



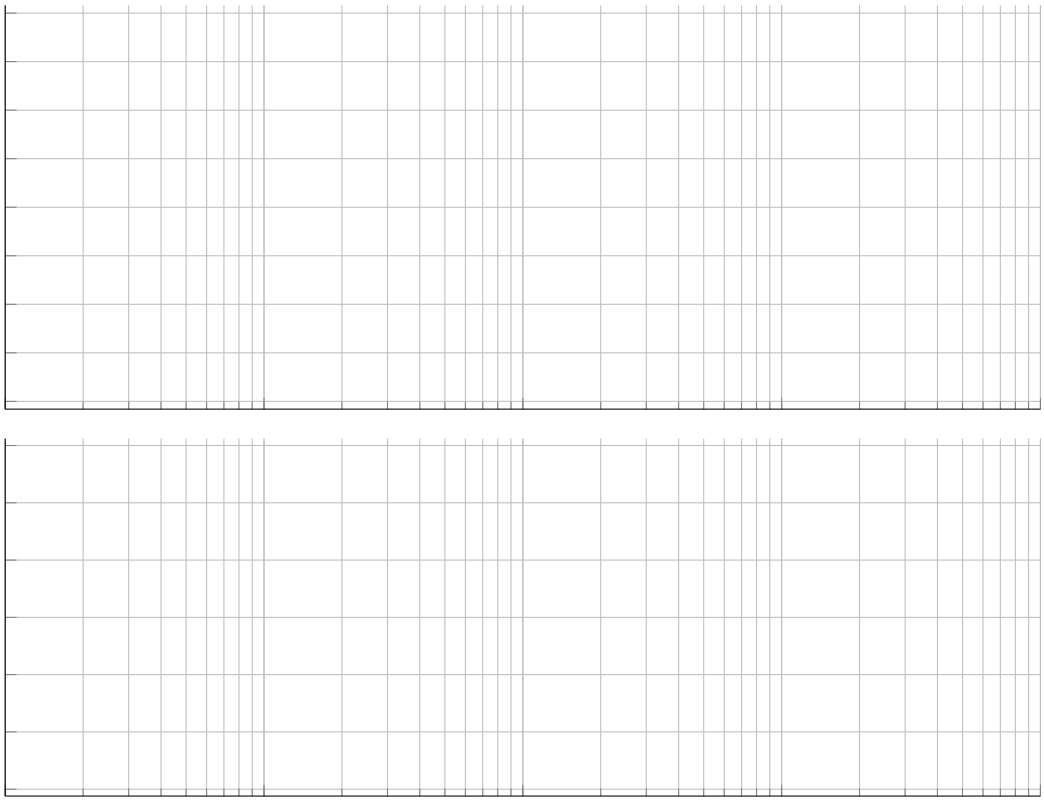
2. 2.(a)



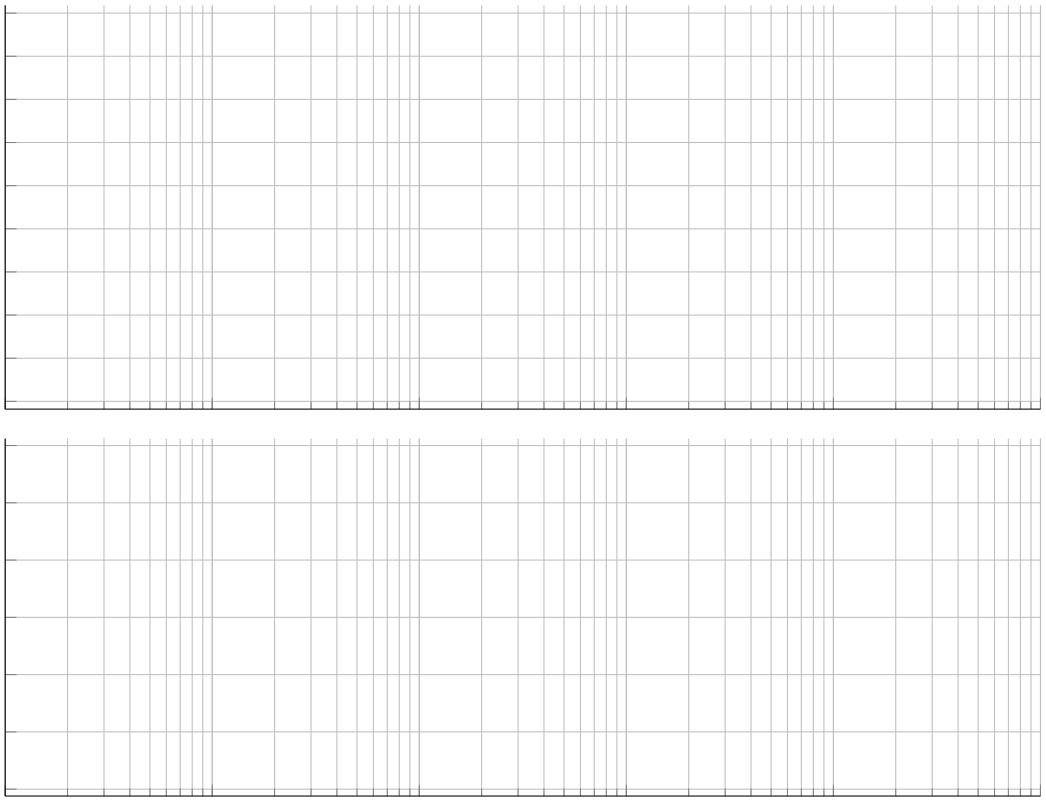
2.(b)



2.(c)



2.(d)

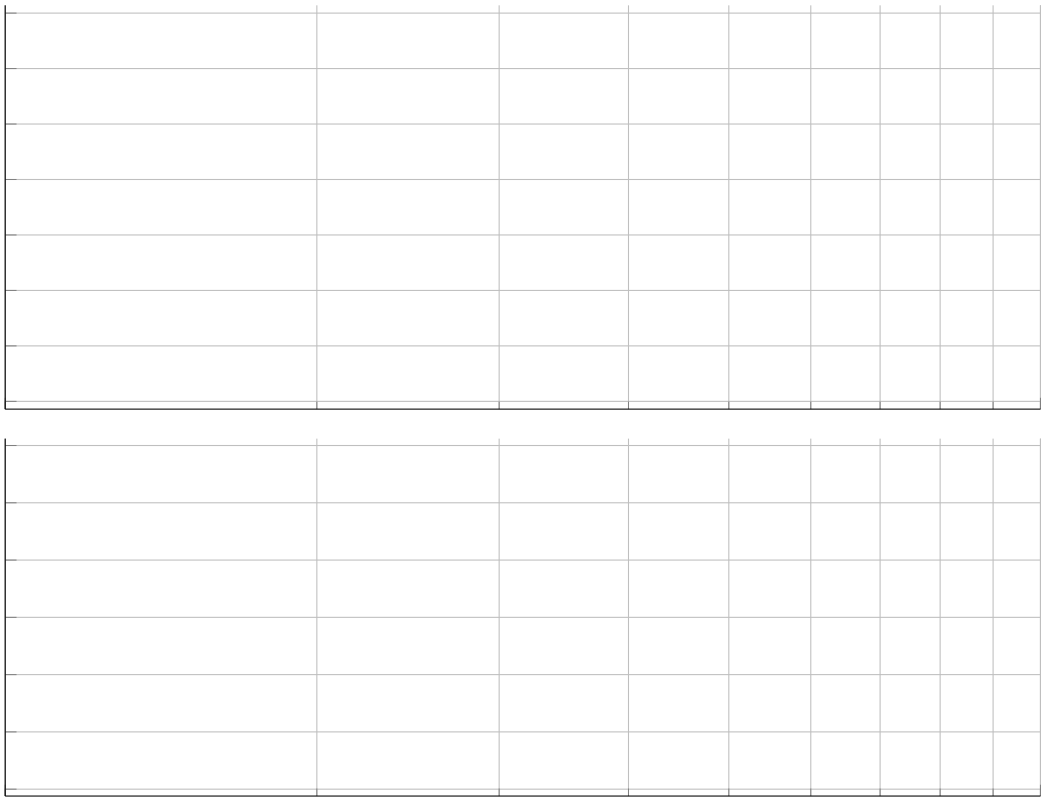


3. 3.(a)

3.(b)

3.(c)

3.(d)



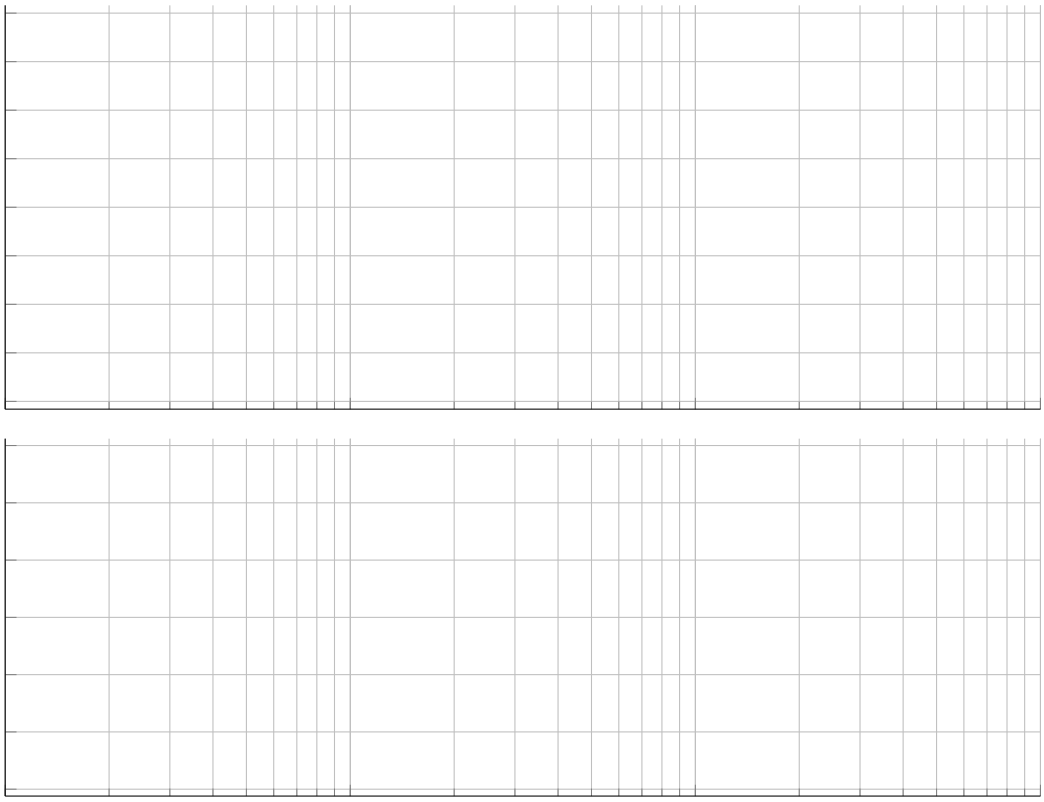
3.(e)

3.(f)

4. 4.(a)

4.(b)

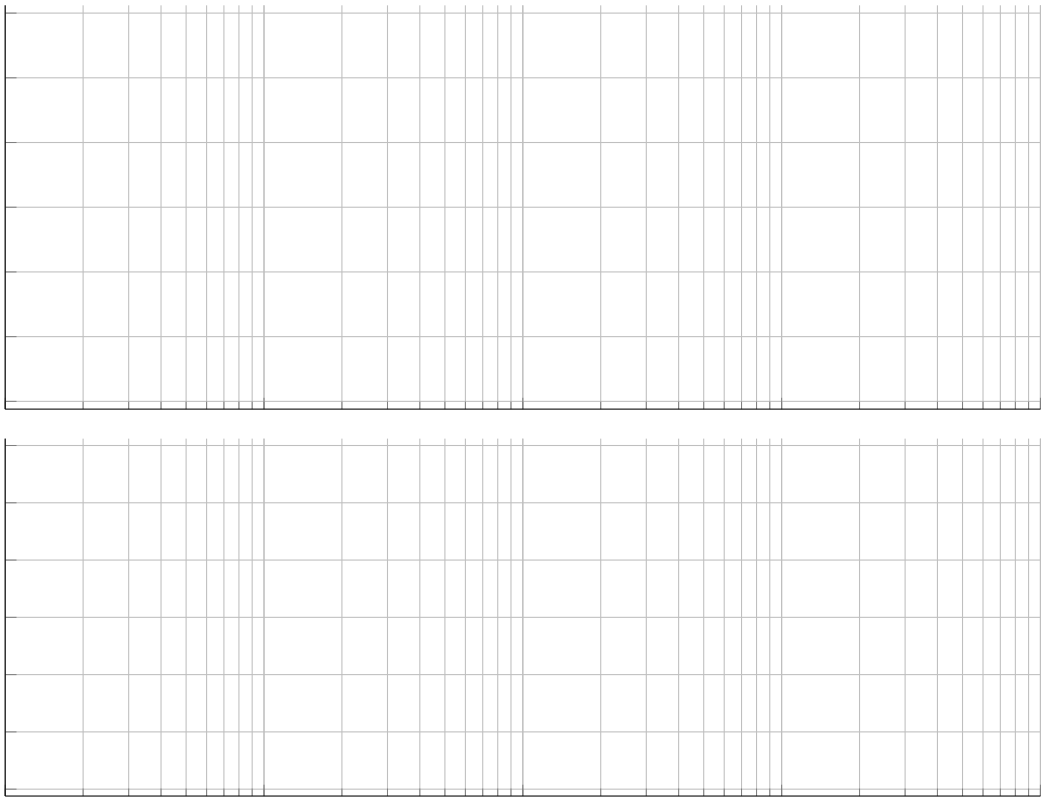
4.(c)



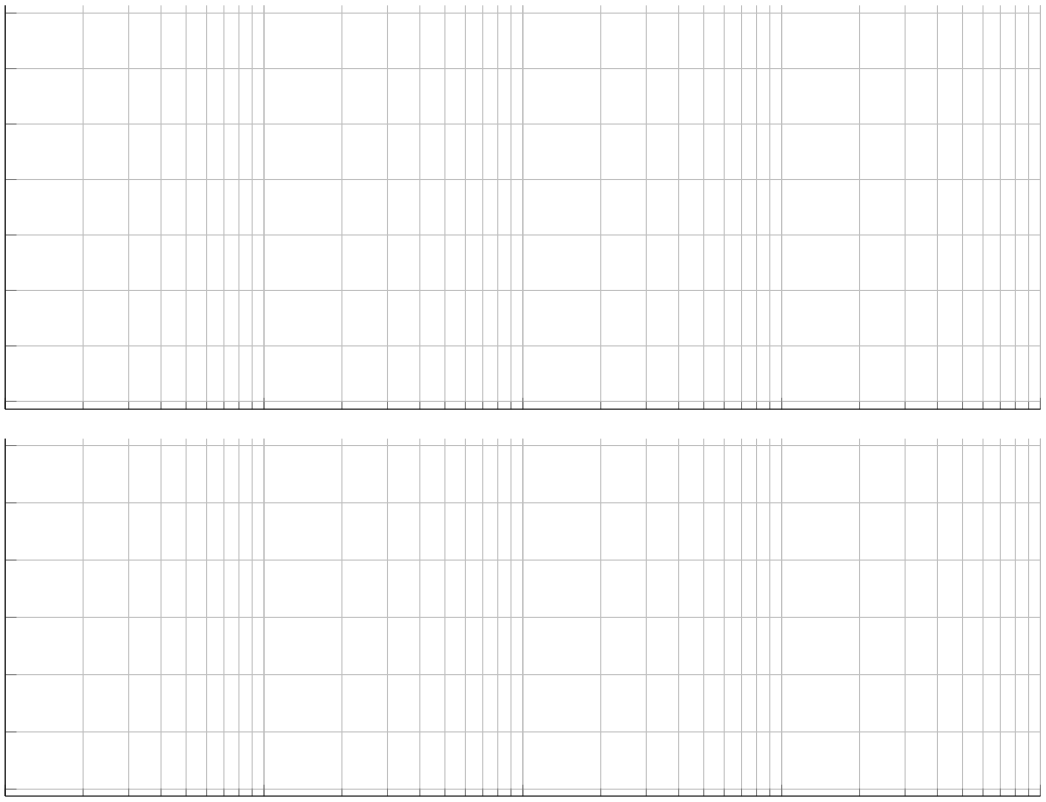
4.(d)

4.(e)

4.(f)



4.(g)



Literatur

[FPE10] Gene F. Franklin, J. David Powel und Abbas Emami-Naeini. *Feedback Control of Dynamic Systems*. 6th international edition. Pearson Prentice Hall, 2010.