1

a) see next page

b) $G(s) = \frac{50}{s^3+13s^2+32s+20} \rightarrow G(jw) = \frac{50}{-w^3j-13w^2+32wj+20}$

$\rightarrow G(jw) = \frac{50}{(-13w^2+20)+j(-w^3+32w)}$

magnitude: $|G(jw)| = \frac{50}{\sqrt{(-13w^2+20)^2+(-w^3+32w)^2}}$

$= \frac{50}{\sqrt{169w^4-520w^2+400+w^6-64w^4+1024w^2}} = \frac{50}{\sqrt{w^6+105w^4+504w^2+400}}$

$\rightarrow M(w) = \frac{50}{\sqrt{(w^2+1)(w^2+4)(w^2+100)}}$

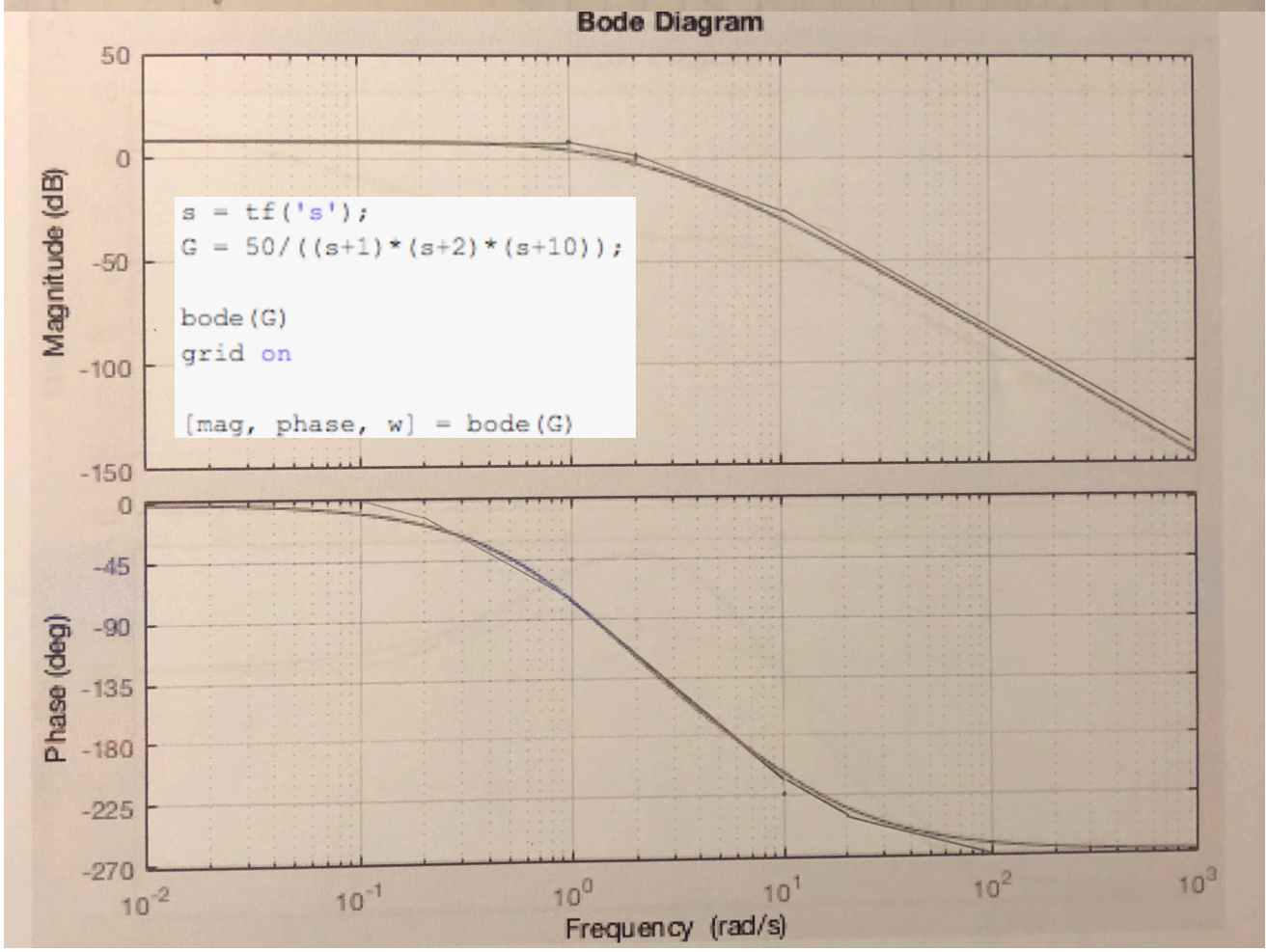
phase: $\angle G(jw) = \tan^{-1}\left(\frac{-w^3+32w}{-13w^2+20}\right)$

c) See MATLAB

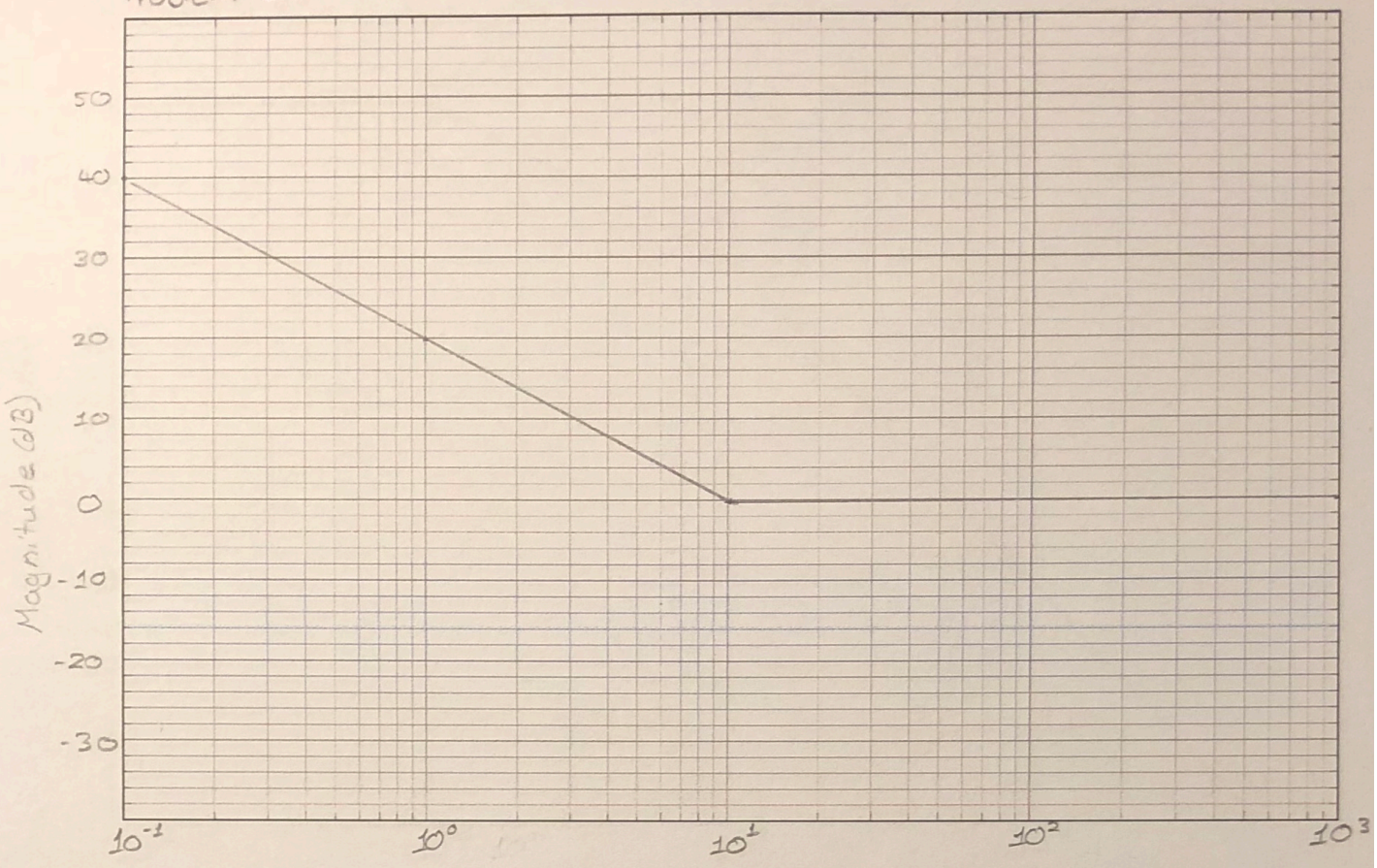
d) see next page for Bode diagram

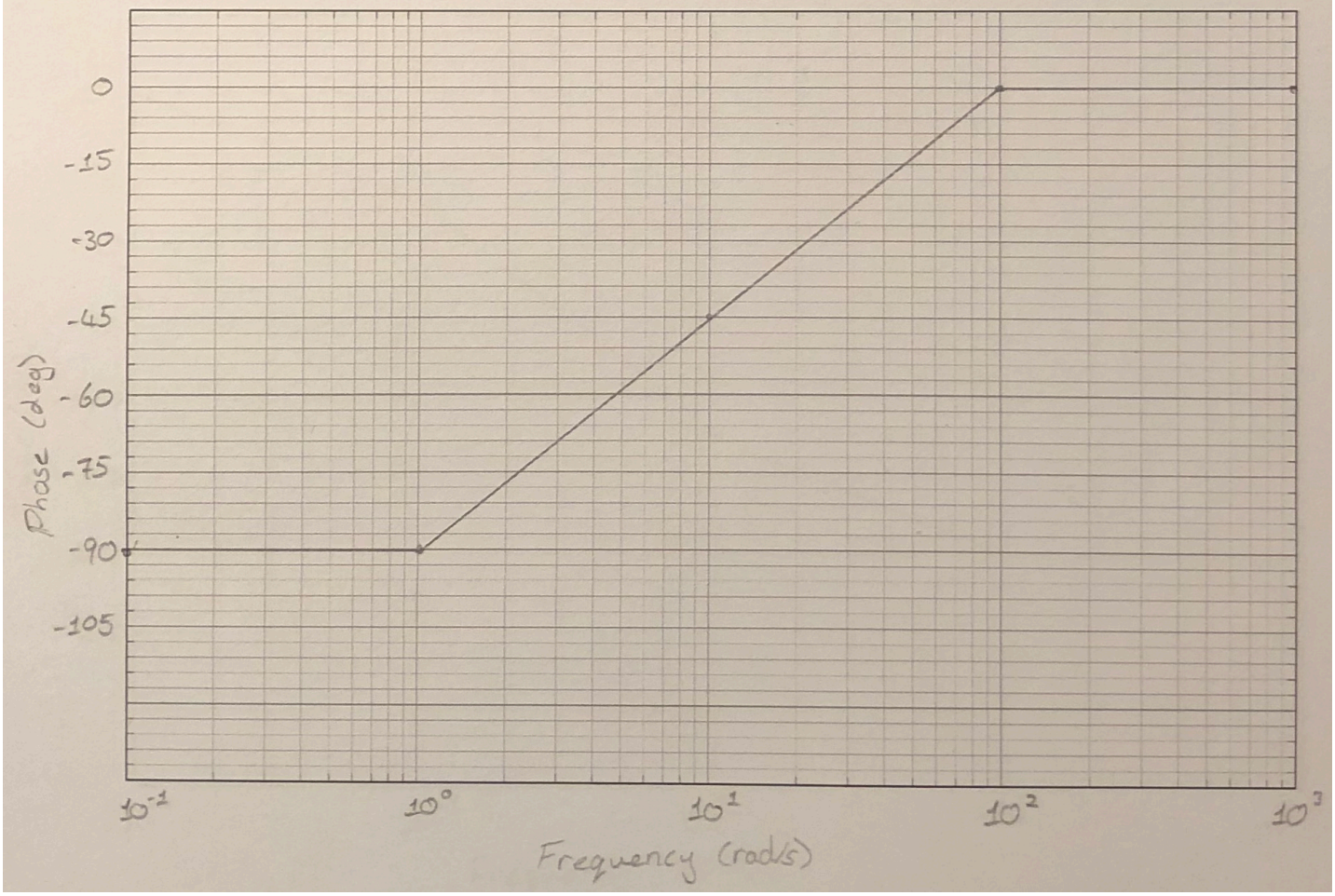
max magnitude error at $w = 1, 2$, error ≈ 4 dB

max degree error at $w = 0.1, 100$, error $\approx 10°$

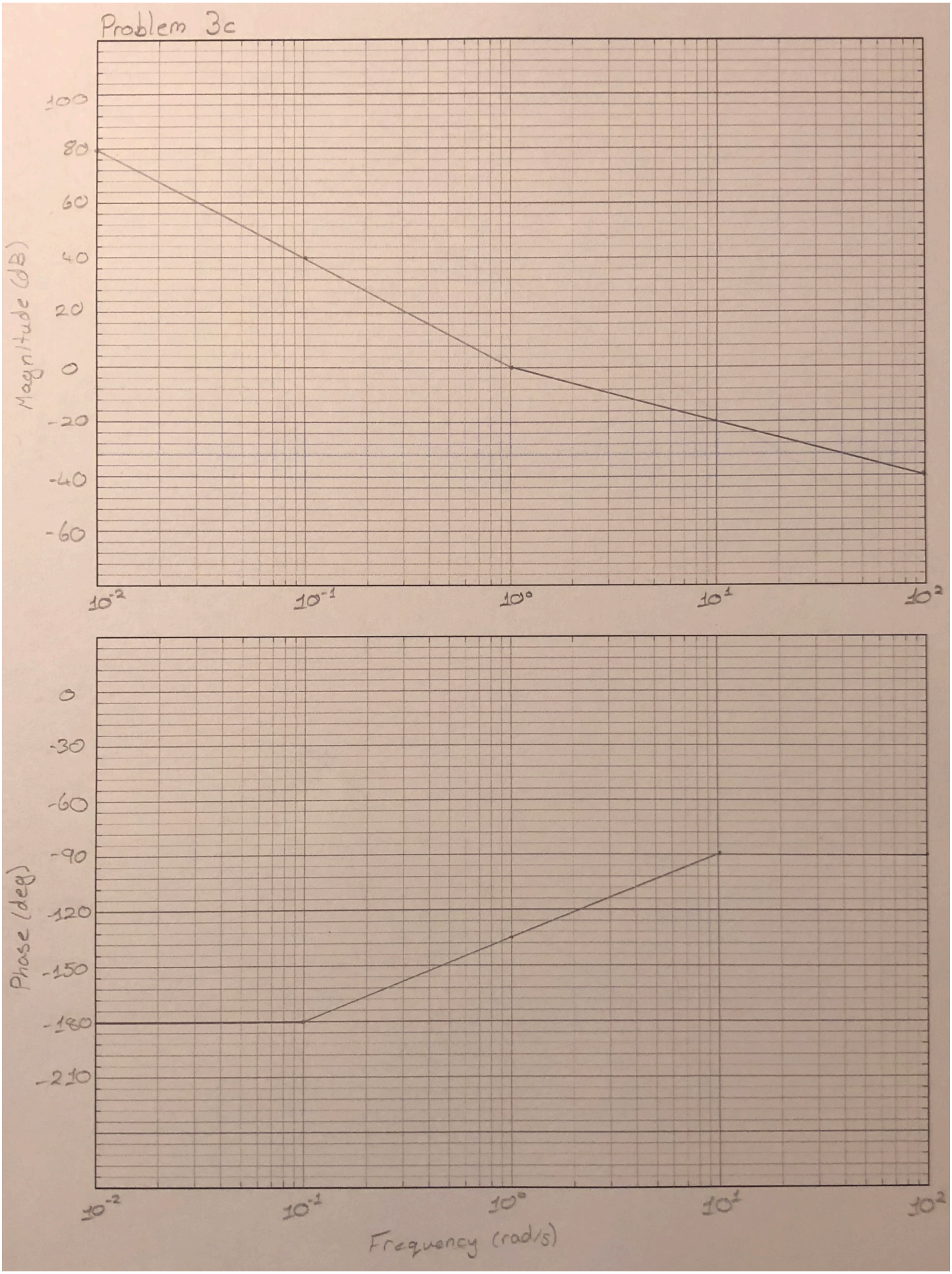


Problem 3a

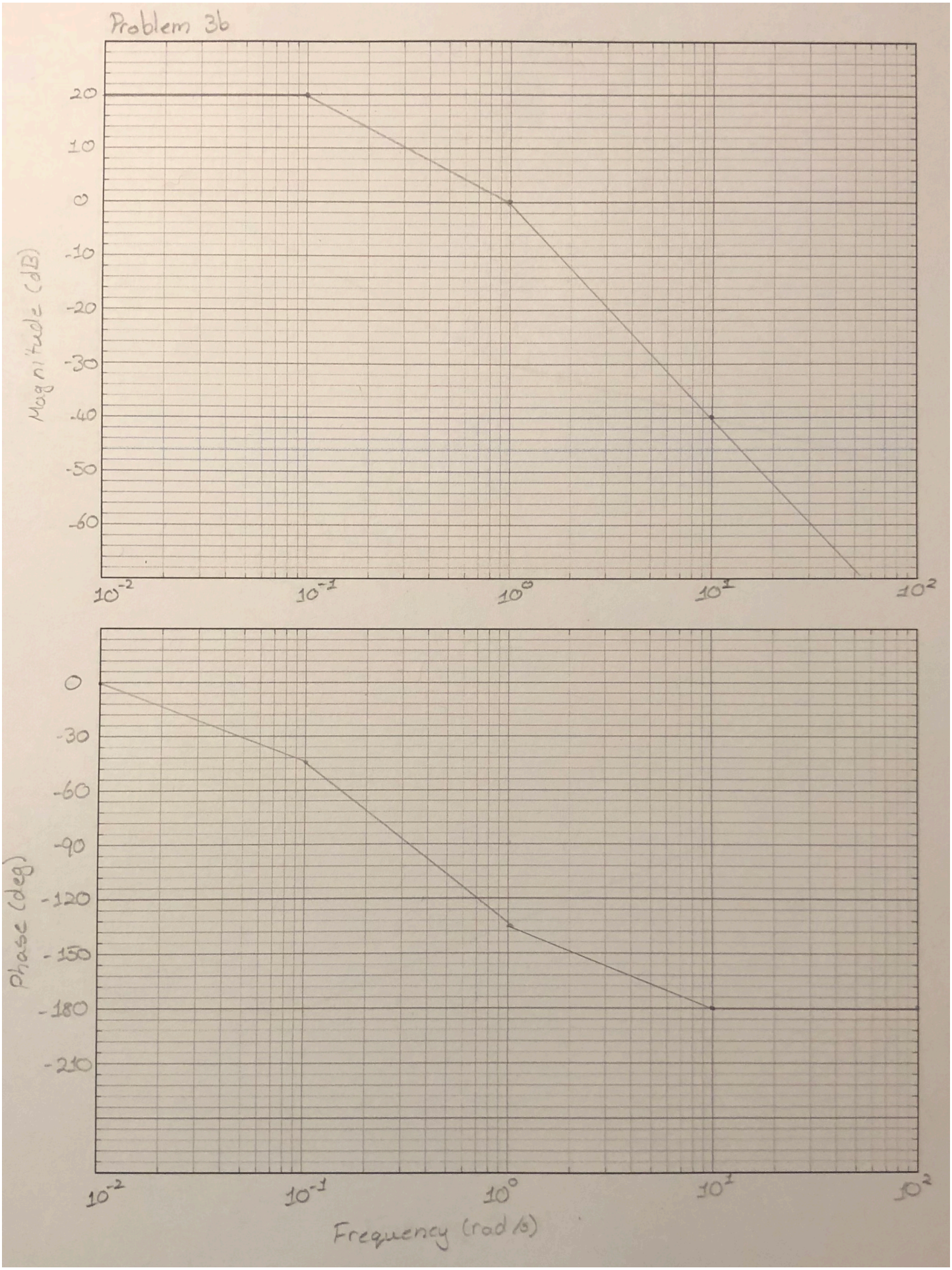

50
40
30
20
10
0
-10
-20
-30
Magnitude (dB)
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}


0
-15
-30
-45
-60
-75
-90
-105
Phase (deg)
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (rad/s)

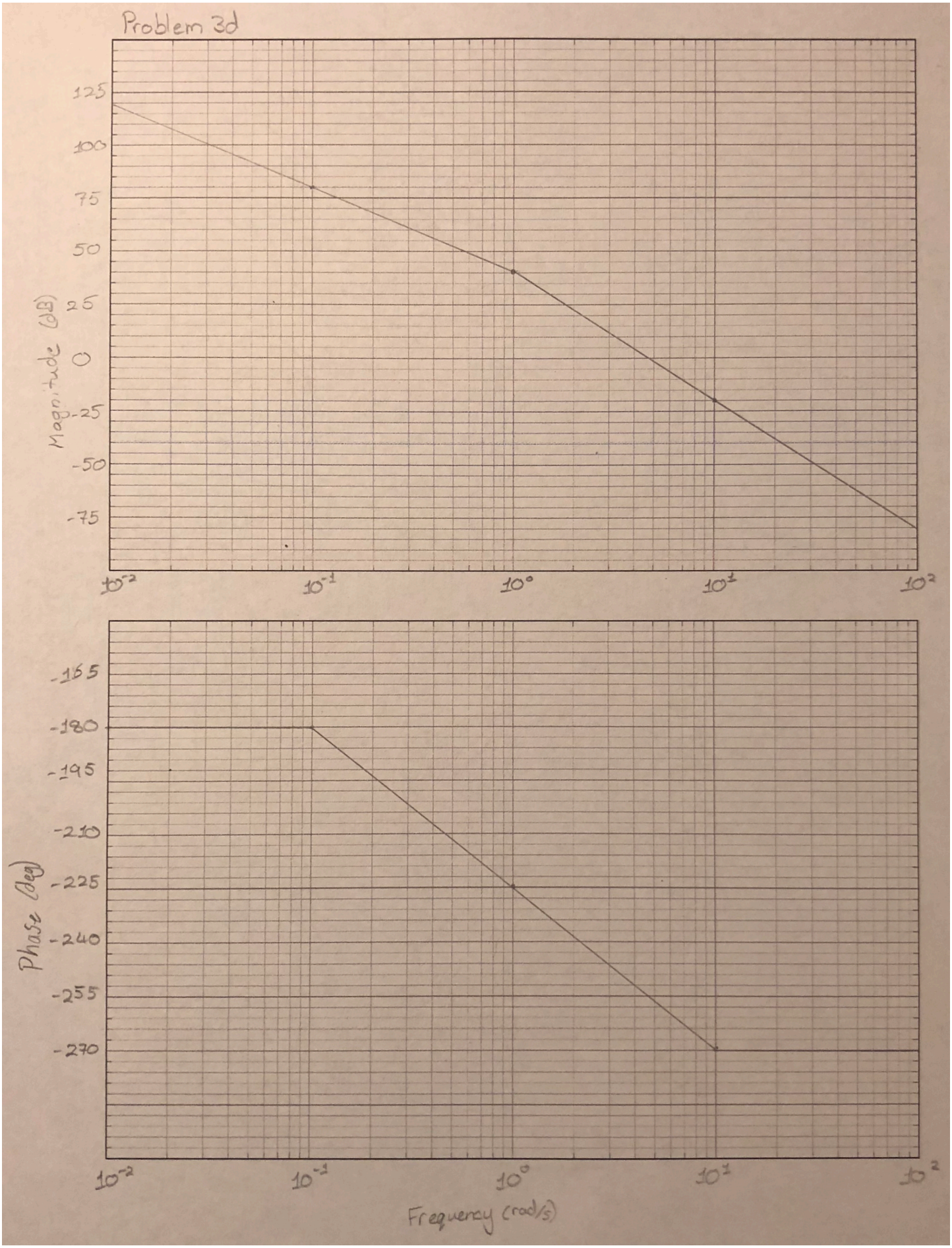
Problem 3c


100
80
60
40
20
0
-20
-40
-60
Magnitude (dB)
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
0
-30
-60
-90
-120
-150
-180
-210
Phase (deg)
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
Frequency (rad/s)

Problem 3b

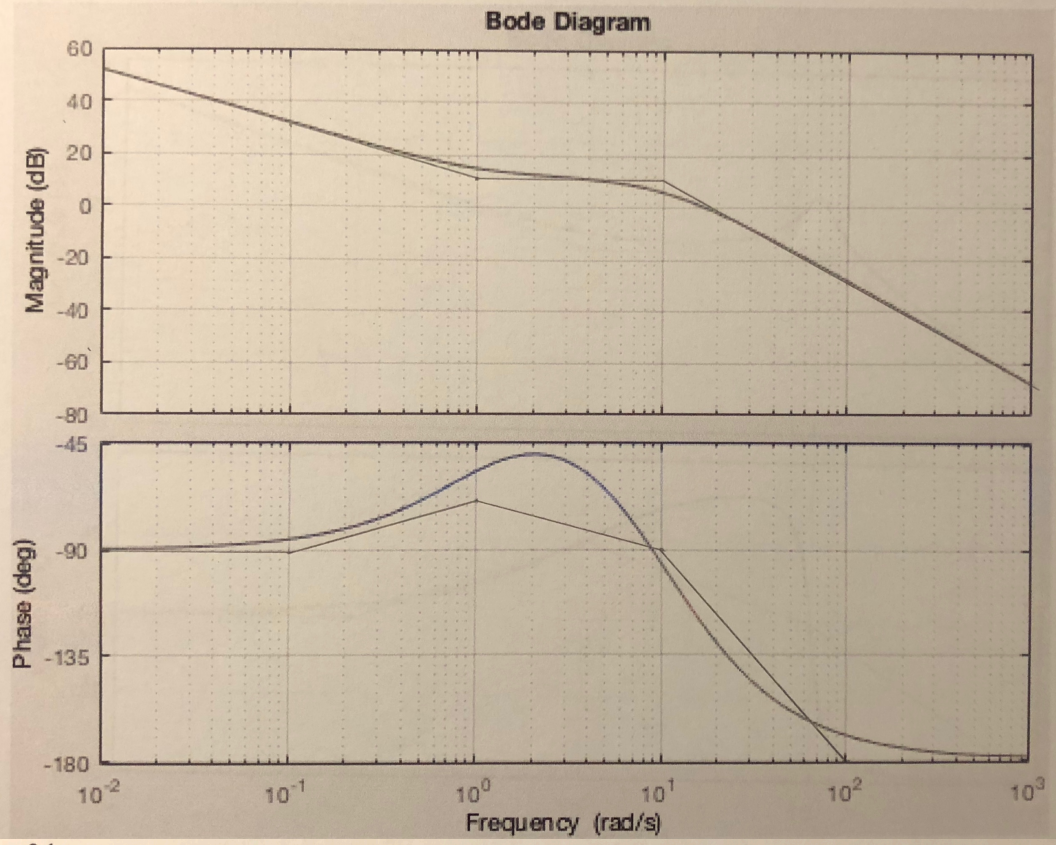

Magnitude (dB)
20
10
0
-10
-20
-30
-40
-50
-60
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
Phase (deg)
0
-30
-60
-90
-120
-150
-180
-210
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
Frequency (rad/s)

Problem 3d

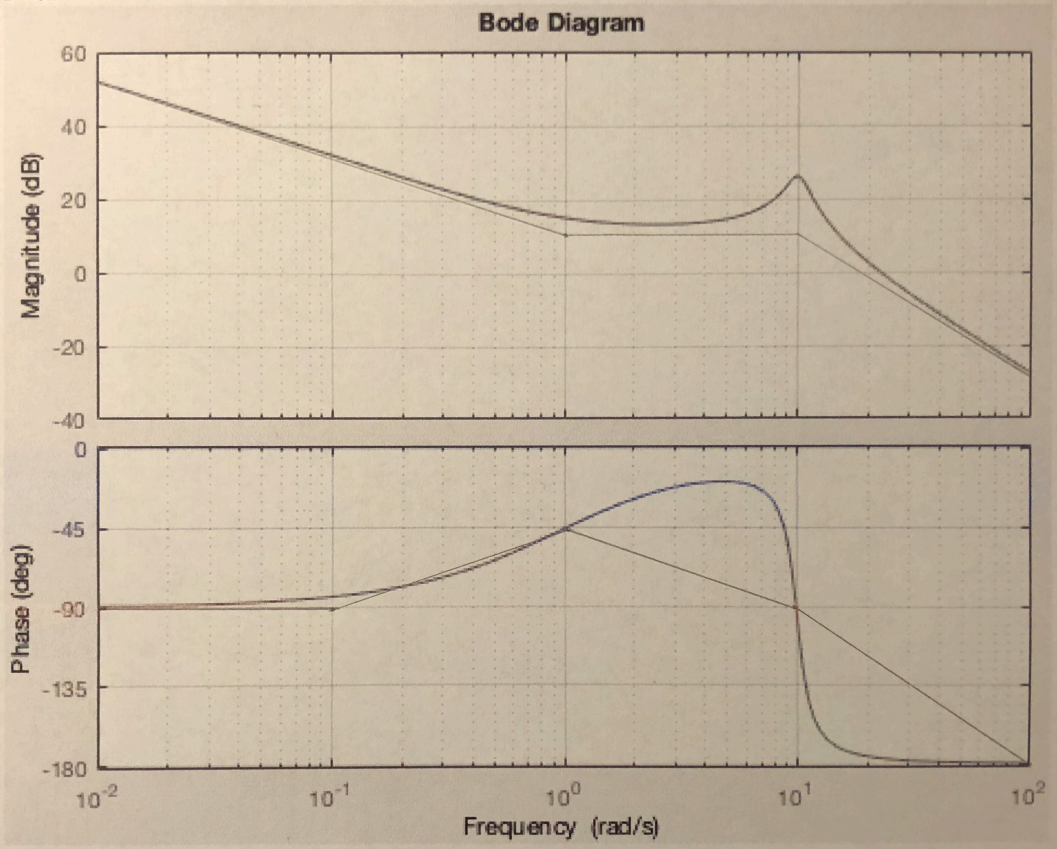

125
100
75
50
25
0
-25
-50
-75
Magnitude (dB)
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
-165
-180
-195
-210
-225
-240
-255
-270
Phase (deg)
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
Frequency (rad/s)

Problem 4

z = 1



z = 0.1



max magnitude error = ~14 dB at w=10

max degree error = ~60° at w = 20