Assignment 0 → S.R Sahoo

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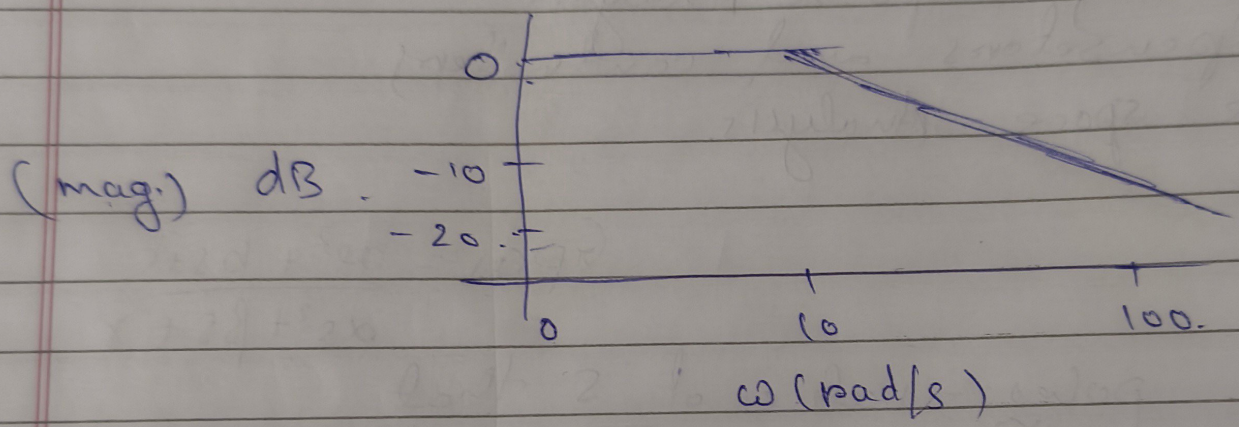
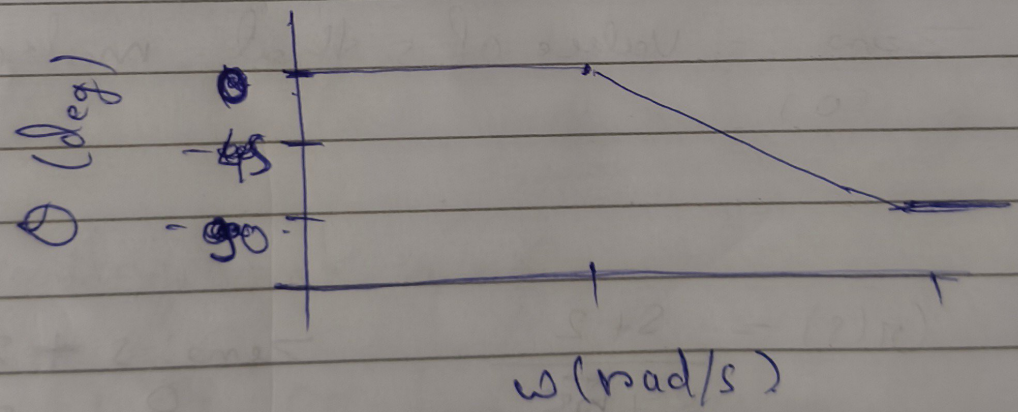
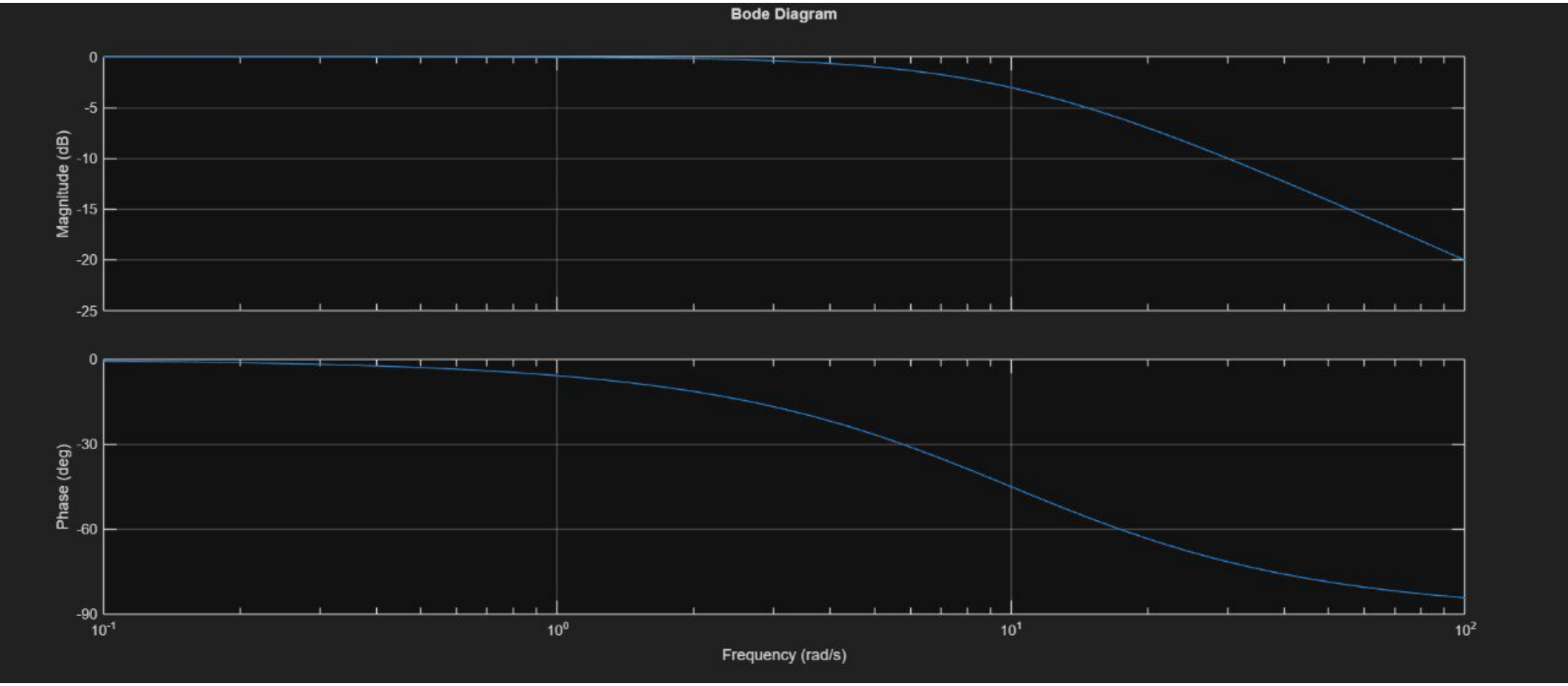
Part A

1.1) → 1) → Pole : $s = -10$, $G_1(0) = \frac{10}{10} = 1$

2) →

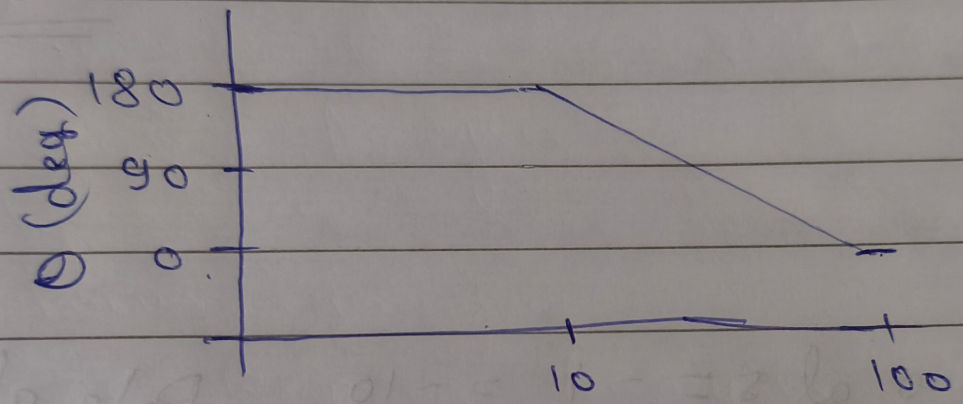


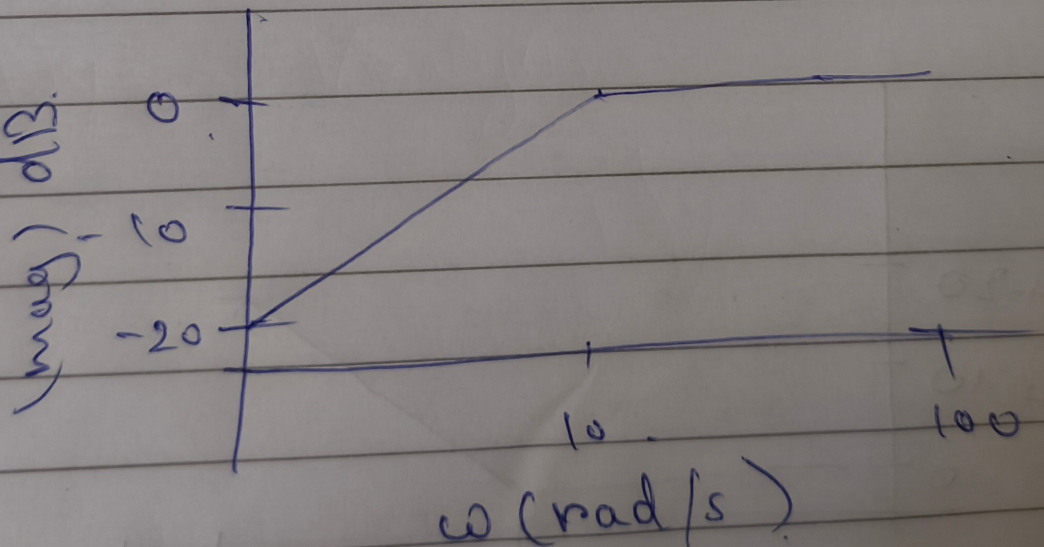


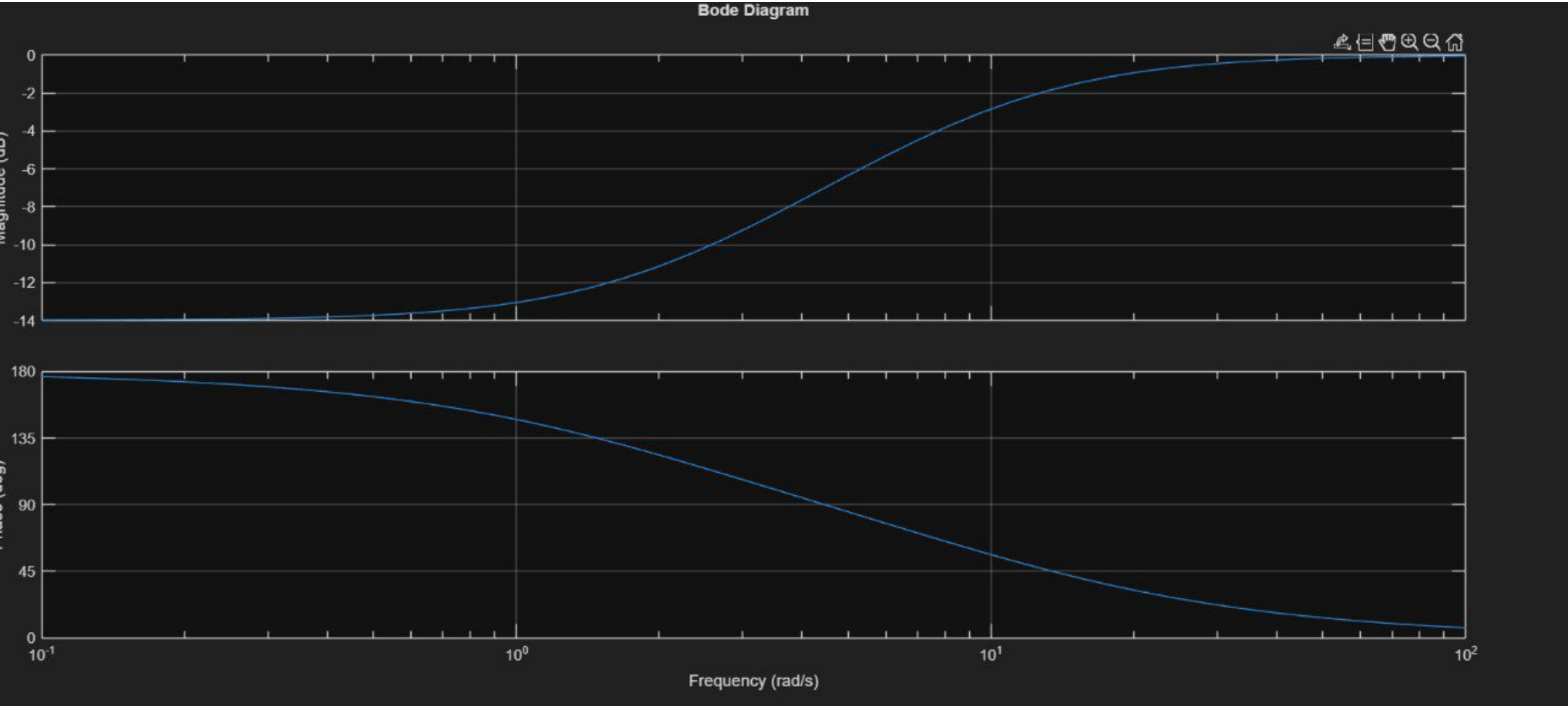

Bode Diagram
Magnitude (dB)
0
-5
-10
-15
-20
-25
Phase (deg)
0
-30
-60
-90
10^{-1}
10^{0}
10^{1}
10^{2}
Frequency (rad/s)

1.2) 1) → Zero: $s = 2$, Pole: $s = -10$, $G_2(0) = \frac{-2}{10} = -0.2$

2) →





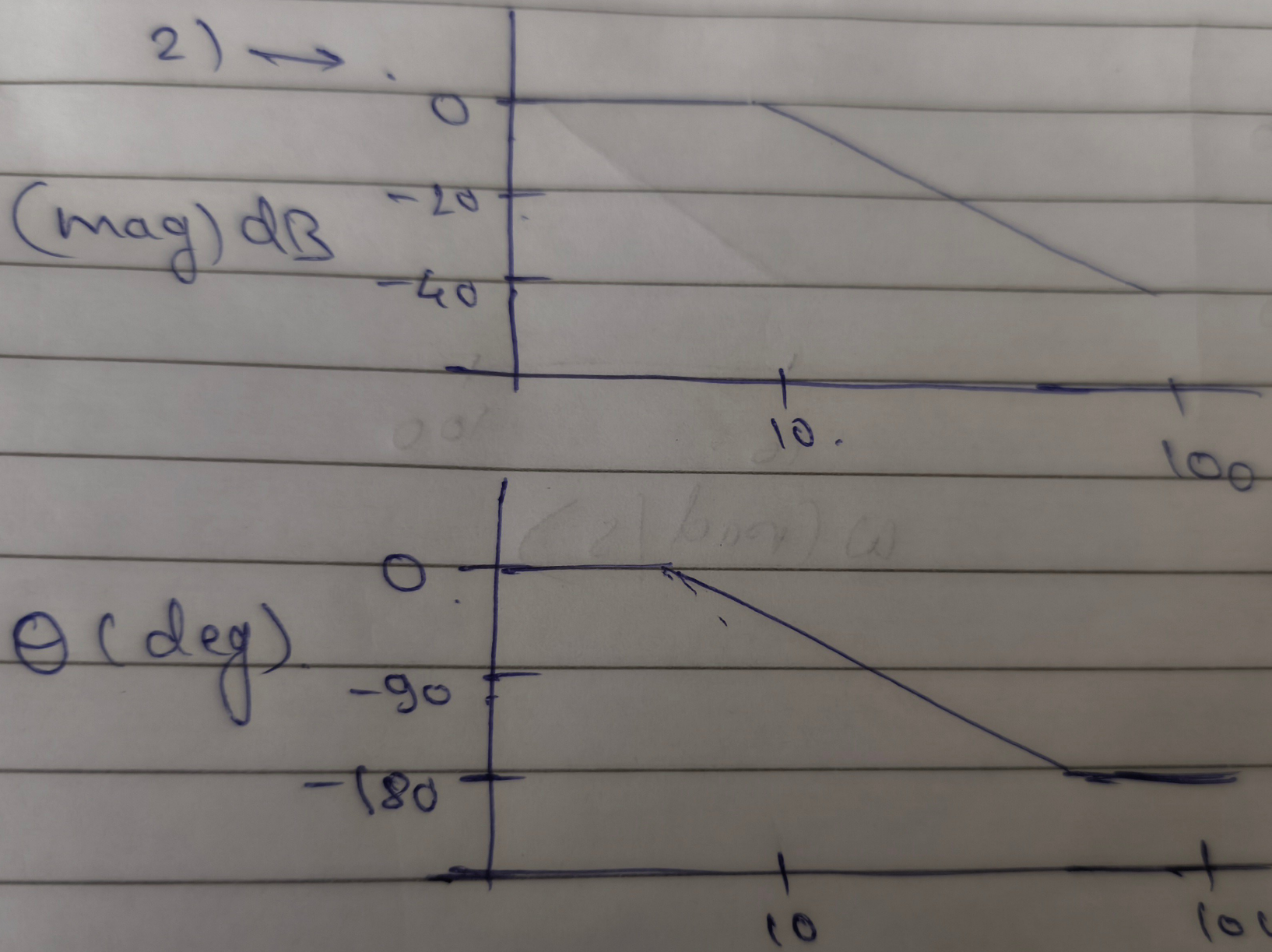

Bode Diagram
0
-2
-4
-6
-8
-10
-12
-14
180
135
90
45
0
10^{-1}
10^{0}
10^{1}
10^{2}
Frequency (rad/s)

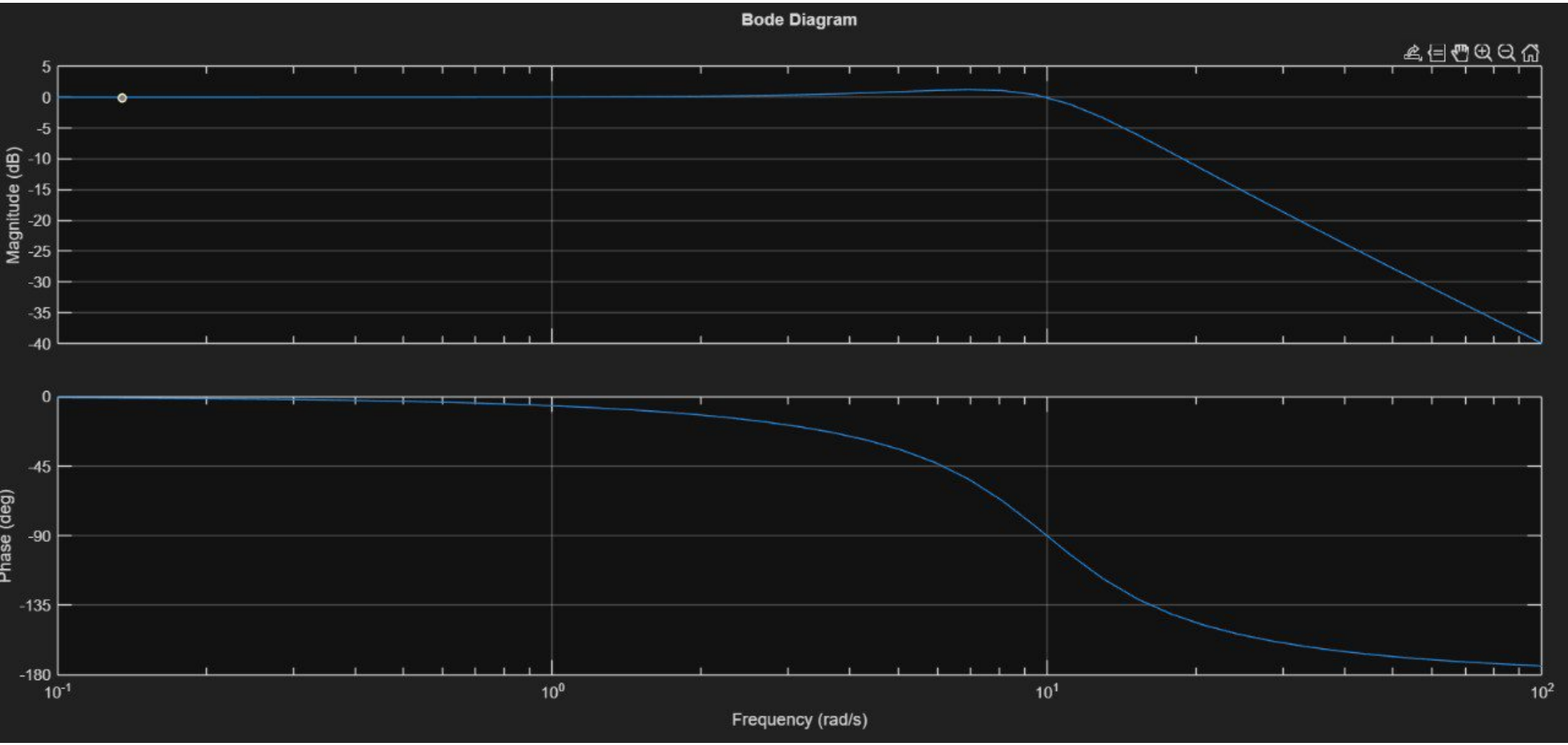
4) → · A right-half-plane zero usually adds negative phase, opposite to left-half-plane zero's positive phase lead.

1.3) 1) $\rightarrow$ $s_{1,2} = \frac{-10 \pm \sqrt{10^2 - 4 \cdot 100}}{2} = \frac{-10 \pm \sqrt{-300}}{2}$

$= -5 \pm j\,8.660$

2) →




Bode Diagram
Magnitude (dB)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
Phase (deg)
0
-45
-90
-135
-180
10^{-1}
10^{0}
10^{1}
10^{2}
Frequency (rad/s)

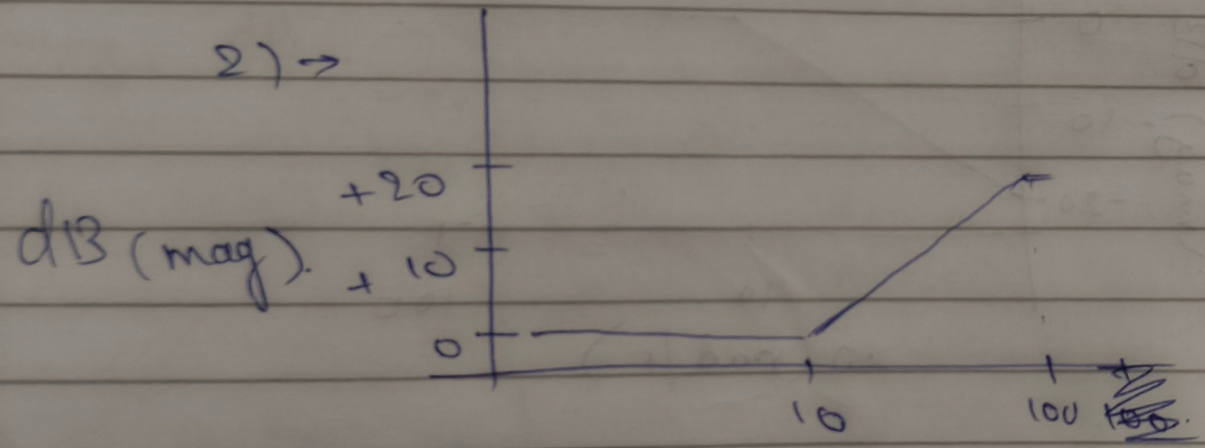
$= -5 \pm j 8.6603$

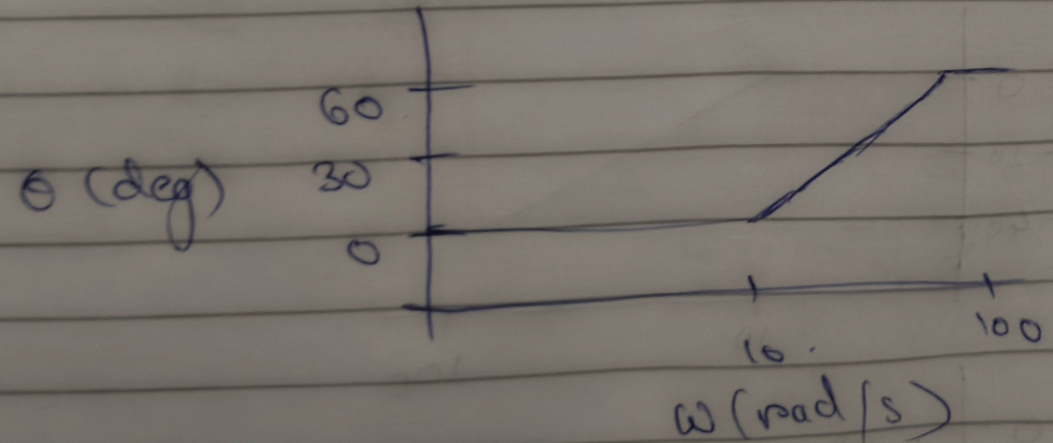
B.1

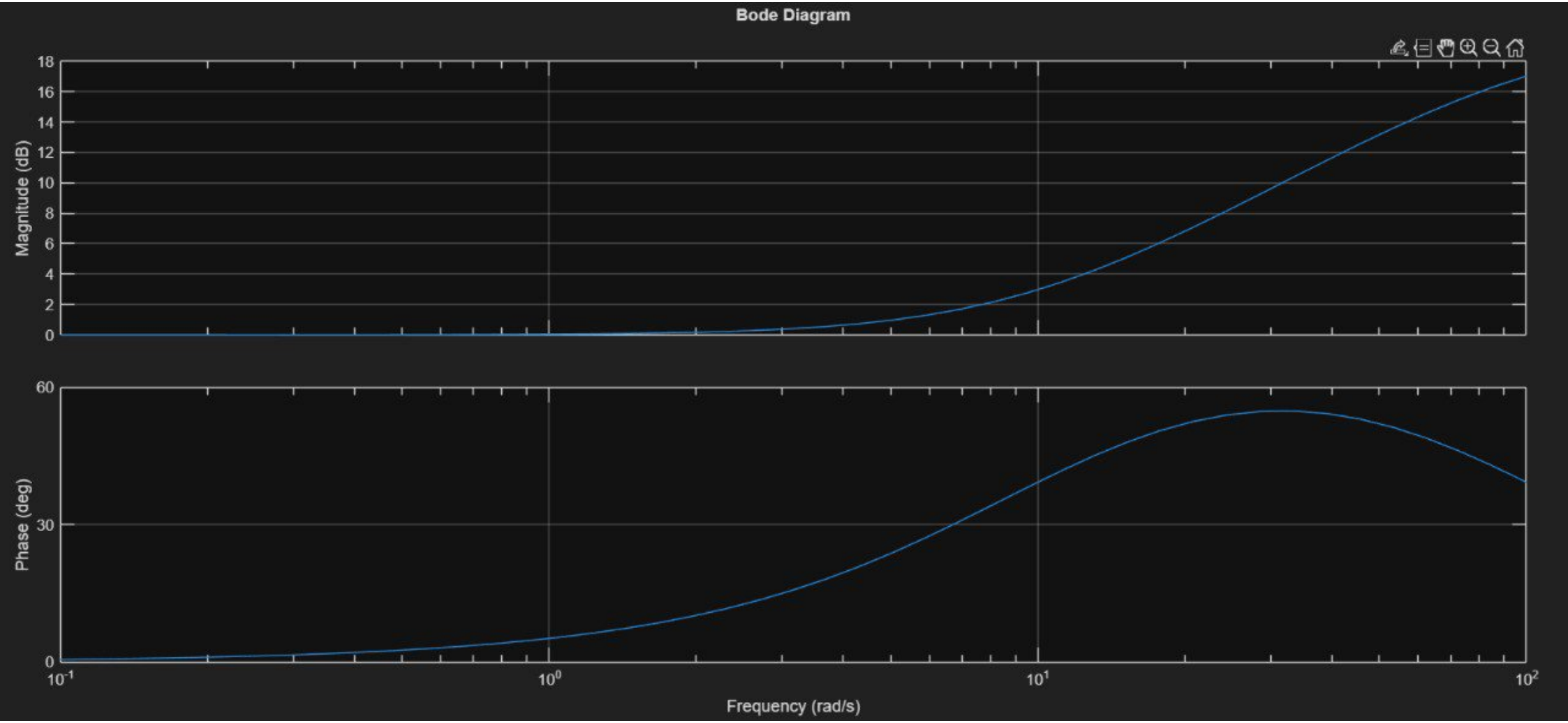
1.4) 1) →

Zero at $s = \frac{-1}{0.1} = -10$, Pole at $s = \frac{-1}{0.01} = -100$.

2) →






Bode Diagram
Magnitude (dB)
18
16
14
12
10
8
6
4
2
0
Phase (deg)
60
30
0
10^{-1}
10^{0}
10^{1}
10^{2}
Frequency (rad/s)

4) → Between the zero and pole, $G_4(s)$ adds positive phase (phase lead).

Part B

B.1) 1) → equation of motion ⇒ $m\ddot{x}(t) + d\dot{x}(t) + cx(t) = F(t)$

2) → Applying Lapalace transform (zero initial cond^n):-

$$ms^2X(s) + dsX(s) + cX(s) = F(s)$$

3) → $G(s) = \frac{X(s)}{F(s)}$

$$\therefore G(s) = \frac{1}{ms^2 + ds + c}$$

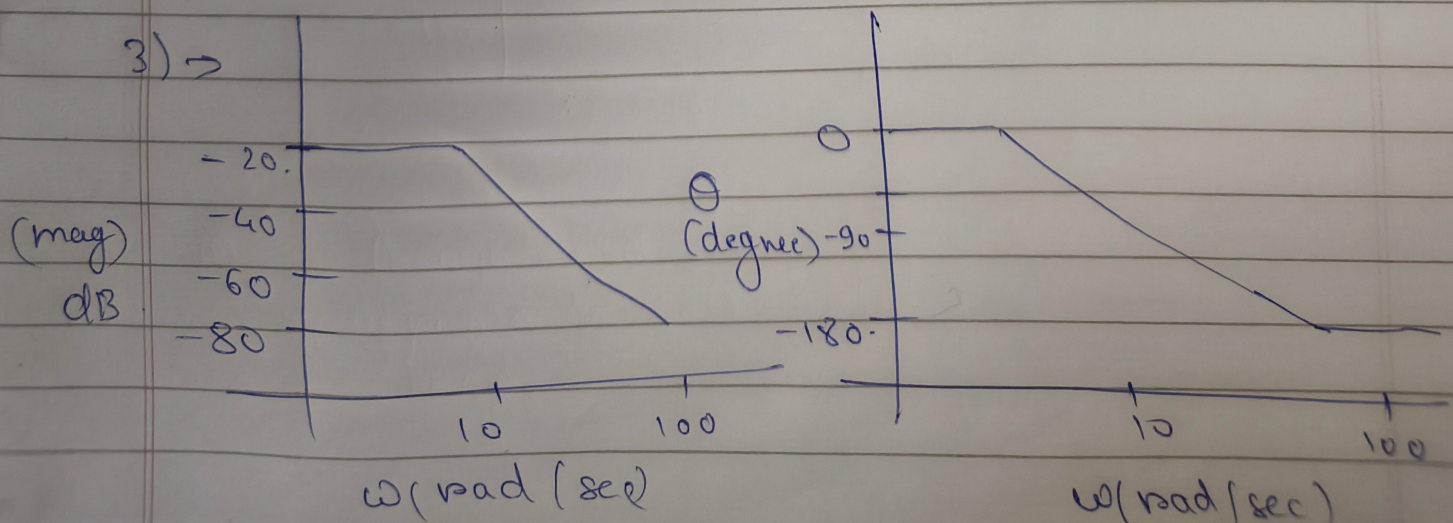
B.2)

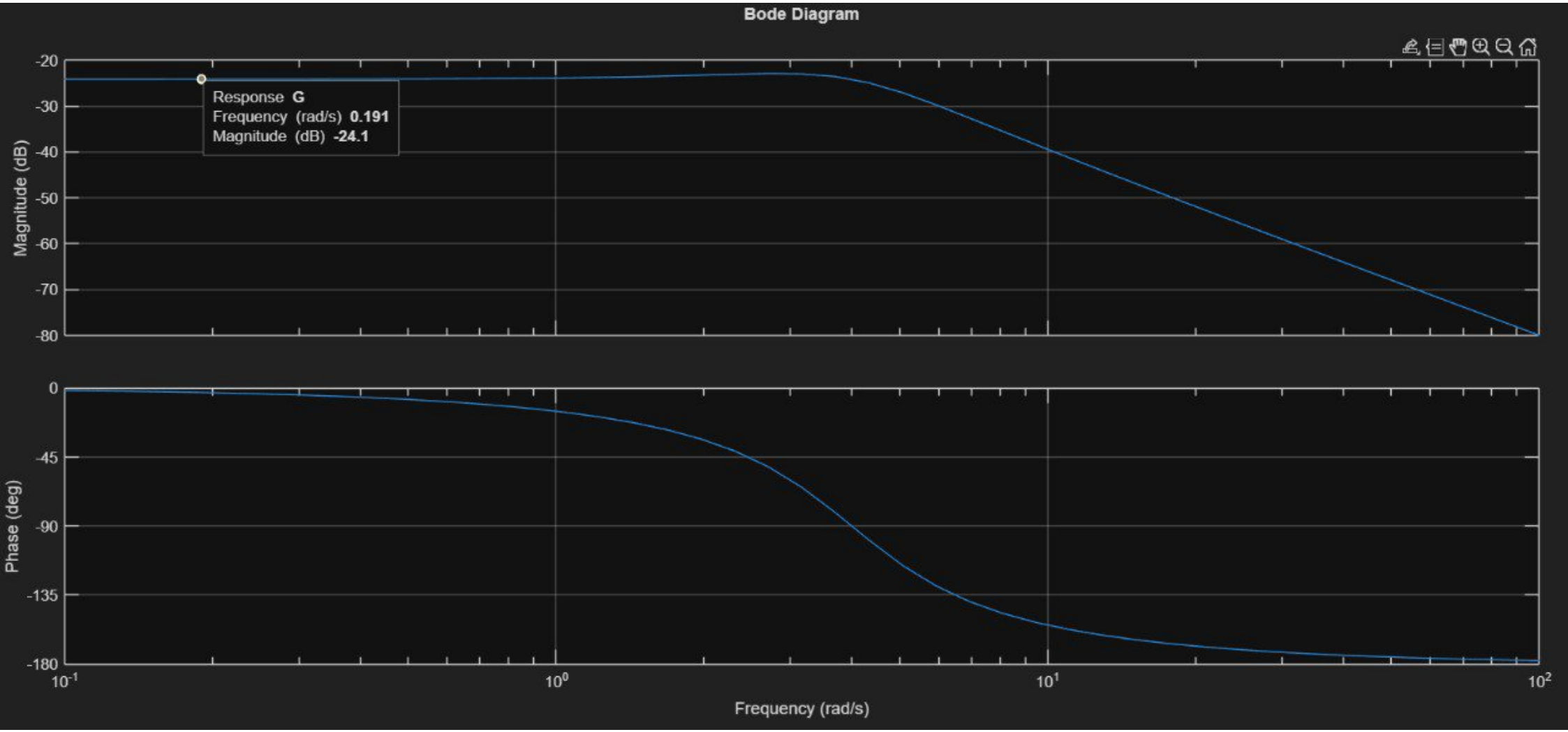
1) → $$G(s) = \frac{1}{s^2 + 4s + 16}$$

2) → $$s_{1,2} = \frac{-4 \pm \sqrt{4^2 - 4.1.16}}{2} = \frac{-4 \pm \sqrt{48}}{2}$$

$$= -2 \pm j3.464i$$

3) →




Bode Diagram
Response G
Frequency (rad/s) 0.191
Magnitude (dB) -24.1
Magnitude (dB)
-20
-30
-40
-50
-60
-70
-80
Phase (deg)
0
-45
-90
-135
-180
10^-1
10^0
10^1
10^2
Frequency (rad/s)