Handout 7: Lag and PI compensation

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Lag Compensation goals: Raise gain at low frequencies while leaving crossover & higher frequencies untouched.

Canonical lag element:

$$K_l(s) = \frac{s+a}{s+b}, \quad a > b \geq 0.$$

When $b = 0$: Add an integrator in the loop

Typical lag Bode Plot:

PI Compensation:

$$
\begin{aligned}
K_{PI}(s) &= K_p + \frac{K_v}{s} \\
&= \quad -
\end{aligned}
$$

Plant under study:

$$
G(s) = \frac{1/10}{(s+1)(s/10+1)^2}
$$

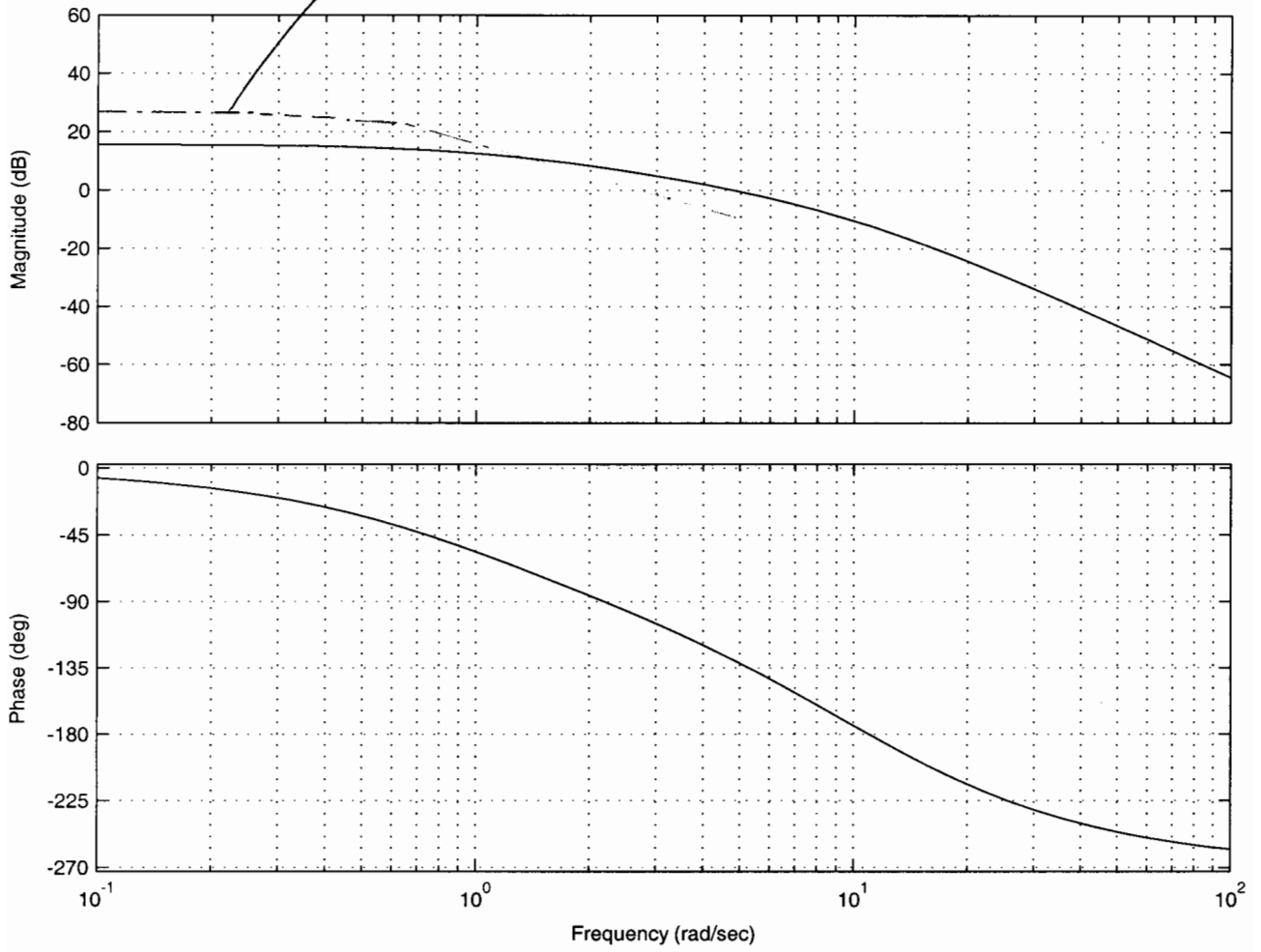Requirements: Keep phase margin at 45 degrees, $BW > 4rad/sec$, must beat $p(j\omega)$.

Compensation Scheme: We first adjust the gain K in the feedback loop to 60.

Phase Margin is

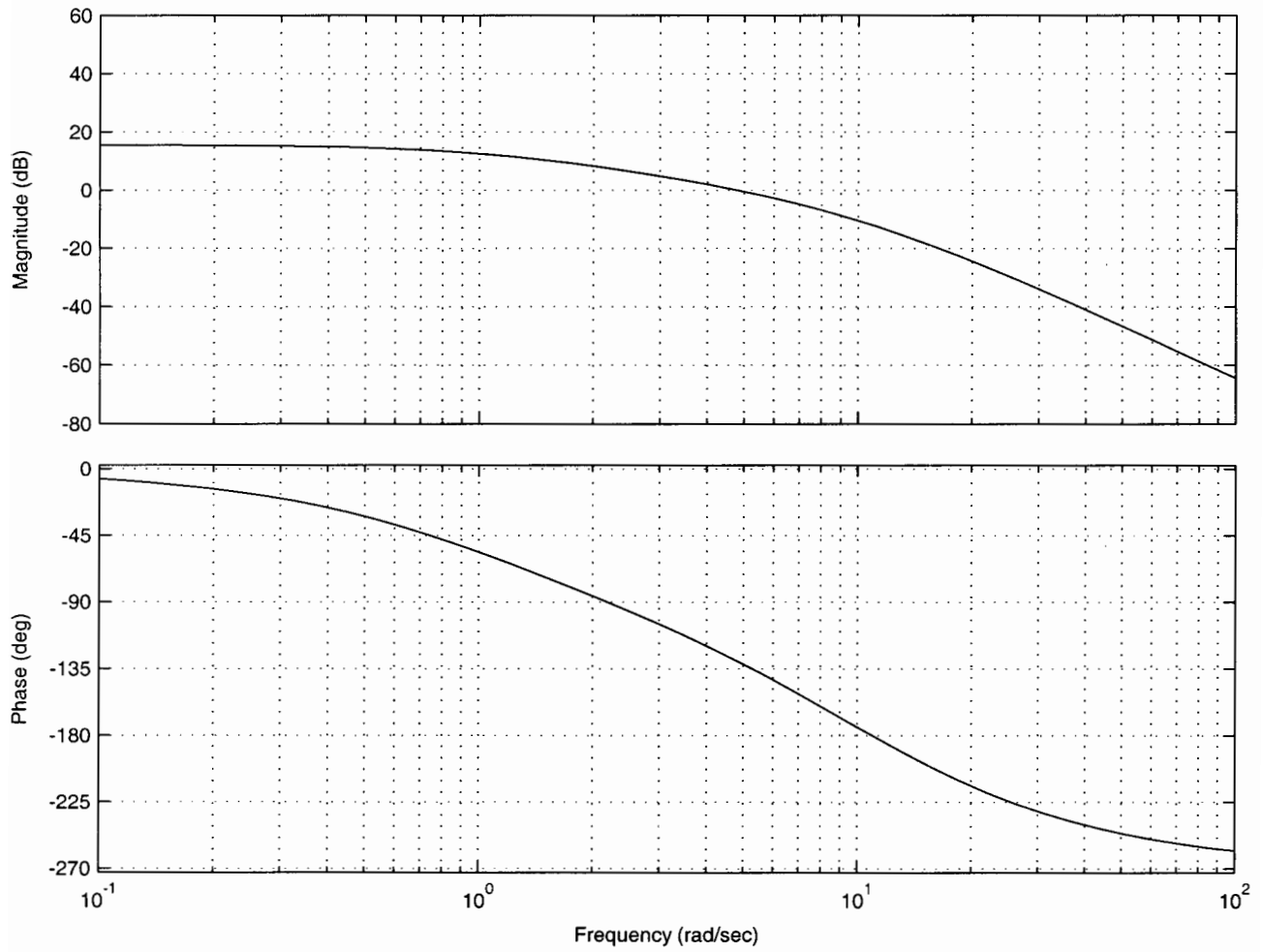Gain Margin is

$p(j\omega)$

Bode Diagram

Lag compensation:

$$K_l(s) = \frac{s + a}{s}$$

Gain and phase for different values of a: $a = 0.5$, 2.5, 5.

Bode Diagram

Final design: Bode plot

Final design: Root locus