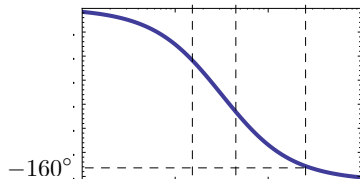
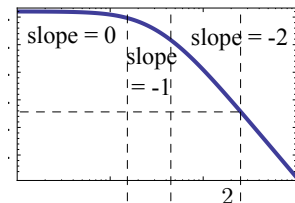


# Lead & Lag Compensation

$$K = 4$$



**Step 2.** Decide how much phase lead is needed, and choose  $z_{\text{lead}}$  and  $p_{\text{lead}}$

Using Matlab, can check:

$$\text{at } \omega = 2, \quad \phi \approx -160^\circ$$

— so PM =  $20^\circ$

(in fact, choosing  $K = 4$  made things worse: it increased  $\omega_c$  and consequently decreased PM)

We need at least  $40^\circ$  phase lead!!

The choice of lead pole/zero must satisfy

$$\sqrt{z_{\text{lead}} \cdot p_{\text{lead}}} \approx 2 \implies z_{\text{lead}} \cdot p_{\text{lead}} = 4$$