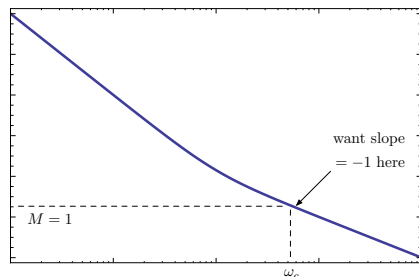


# Bode's Gain-Phase Relationship

Gain-Phase Relationship. Far enough from break-points,

$$\text{Phase} \approx \text{Magnitude Slope} \times 90^\circ$$

This suggests the following rule of thumb:



- ▶  $M$  has slope  $-2$  at  $\omega_c$   
 $\Rightarrow \phi(\omega_c) = -180^\circ$   
 $\Rightarrow$  **bad** (no PM)
- ▶  $M$  has slope  $-1$  at  $\omega_c$   
 $\Rightarrow \phi(\omega_c) = -90^\circ$   
 $\Rightarrow$  **good** (PM =  $90^\circ$ )

— this is an important *design guideline*!!

(Similar considerations apply when  $M$ -plot has positive slope – depends on the t.f.)