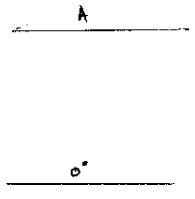
BODE PLOT SUMMARY SHEET

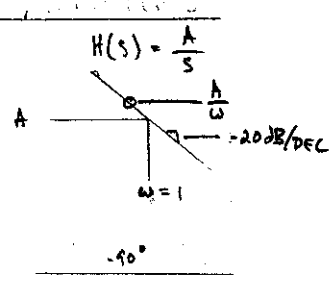
TRANSFER FUNCTION

$H(s) = A$



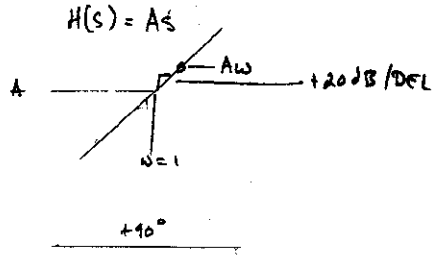
STRAIGHT PATH

$H(s) = \frac{A}{s}$



POLE (AT ZERO)

$H(s) = As$



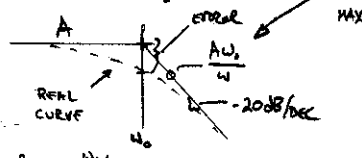
ZERO (AT ZERO)

TRANSFER FUNCTION

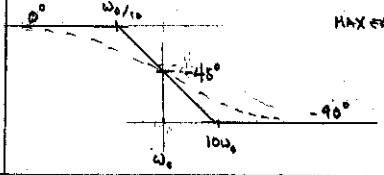
$H(s) = \frac{A}{1 + s/\omega_0}$

IF $\omega >> \omega_0$, $H(s) = \frac{A}{\omega/\omega_0} = \frac{A\omega_0}{\omega}$

MAGNITUDE RESPONSE



PHASE RESPONSE



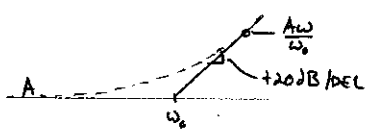
MAX ERROR @ $\omega_0/10$ & $10\omega_0$ = ±5.7°

EXACT VALUE: $-\tan^{-1}\left(\frac{\omega}{\omega_0}\right)$

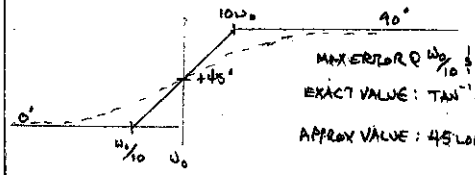
APPROX VALUE: $-45\log_{10}\left(\frac{10\omega}{\omega_0}\right)$

$H(s) = A\left(1 + \frac{s}{\omega_0}\right)$

MAGNITUDE RESPONSE



PHASE RESPONSE



MAX ERROR @ $\omega_0/10$ & $10\omega_0$ = 5.7°

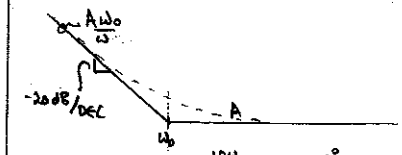
EXACT VALUE: $\tan^{-1}\left(\frac{\omega}{\omega_0}\right)$

APPROX VALUE: $45\log_{10}\left(\frac{10\omega}{\omega_0}\right)$

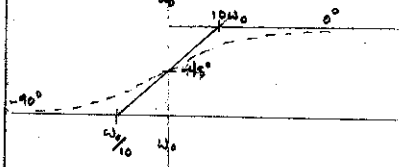
TRANSFER FUNCTION

$H(s) = A\left(1 + \frac{\omega_0}{s}\right)$ (INVERTED ZERO)

MAGNITUDE RESPONSE

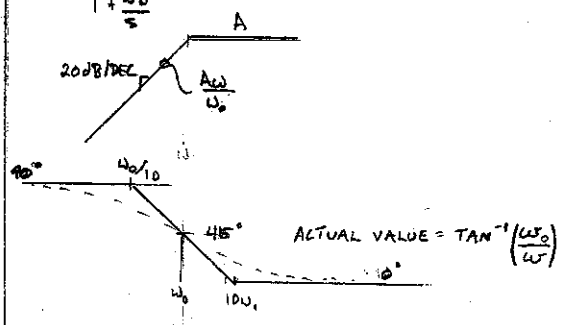


PHASE RESPONSE



ACTUAL VALUE = $+\tan^{-1}\left(\frac{\omega_0}{\omega}\right)$

$H(s) = \frac{A}{1 + \frac{\omega_0}{s}}$ (INVERTED POLE)

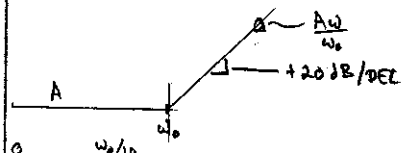


ACTUAL VALUE = $\tan^{-1}\left(\frac{\omega_0}{\omega}\right)$

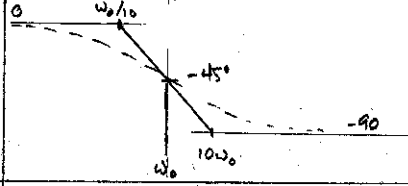
TRANSFER FUNCTION

$H(s) = A\left(1 - \frac{s}{\omega_0}\right)$ (RIGHT-HAND PLANE ZERO)

MAGNITUDE RESPONSE



PHASE RESPONSE



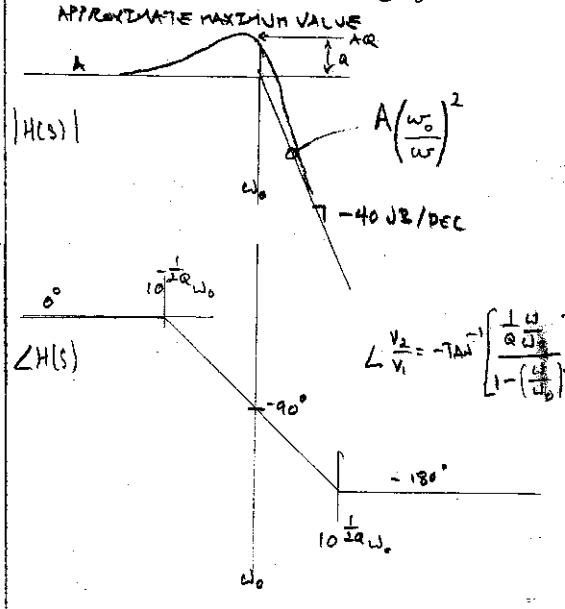
ACTUAL VALUE = $-\tan^{-1}\left(\frac{\omega}{\omega_0}\right)$

$H(s) = \frac{A}{1 + \frac{1}{Q}\left(\frac{s}{\omega_0}\right) + \frac{s^2}{\omega_0^2}}$ SECOND ORDER COMPLEX POLE

ω_0 = CORNER FREQUENCY $Q > \frac{1}{2}$ ⇒ COMPLEX ROOTS

Q = QUALITY FACTOR: EXACT GAIN @ ω_0

APPROXIMATE MAXIMUM VALUE

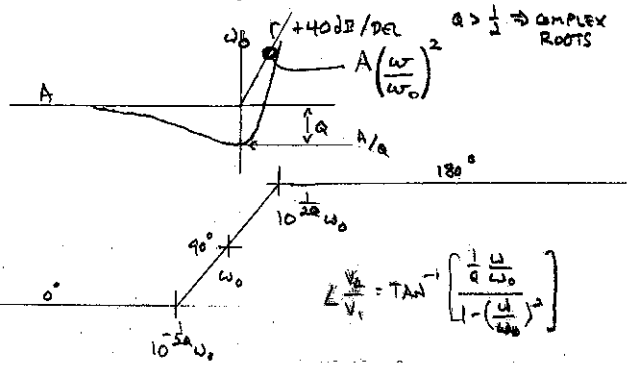


TRANSFER FUNCTION

$H(s) = A\left(1 + \frac{1}{Q}\left(\frac{s}{\omega_0}\right) + \frac{s^2}{\omega_0^2}\right)$ SECOND ORDER COMPLEX ZERO

$Q > \frac{1}{2}$ ⇒ COMPLEX ROOTS

MAGNITUDE RESPONSE



PHASE RESPONSE

$\angle \frac{V_2}{V_1} = \tan^{-1}\left[\frac{\frac{1}{Q}\frac{\omega}{\omega_0}}{1 - \left(\frac{\omega}{\omega_0}\right)^2}\right]$

$\angle \frac{V_2}{V_1} = -\tan^{-1}\left[\frac{\frac{1}{Q}\frac{\omega}{\omega_0}}{1 - \left(\frac{\omega}{\omega_0}\right)^2}\right]$