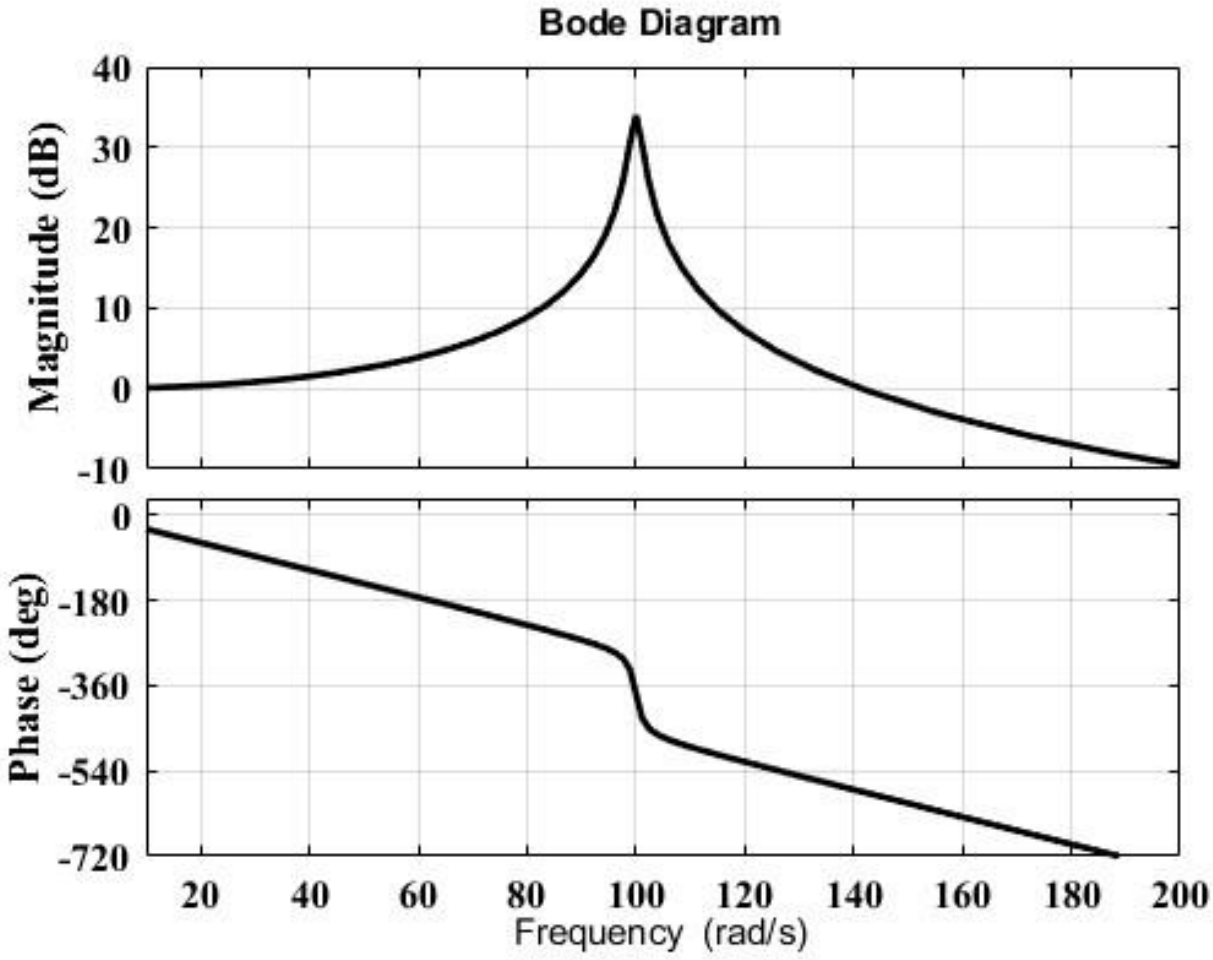
GATE IN 43

EE23BTECH11022 - G DILIP REDDY

Question:
The magnitude and phase plots shown in the figure match with the transfer- function



a) $\frac{10000}{s^2+2s+10000}$

b) $\frac{10000}{s^2+2s+10000}e^{-0.05s}$

c) $\frac{10000}{s^2+2s+10000}e^{-0.5\times10^{-12}s}$

d) $\frac{100}{s^2+2s+100}$

(GATE IN 2023)

Solution: Drawing bode plots for four options.

$$\implies H(s) = \frac{k}{s^2 + 2s + k} e^{as} \tag{1}$$

$$H(j\omega) = \frac{k}{k - \omega^2 + 2j\omega} e^{aj\omega} \tag{2}$$

$$|H(j\omega)| = \frac{k}{\sqrt{(k - \omega^2)^2 + 4\omega^2}} \tag{3}$$

$$\implies \phi(H(j\omega)) = \left(-\tan^{-1}\left(\frac{2\omega}{k - \omega^2}\right) - a\omega \right) \tag{4}$$

From the graphs , the answer is b

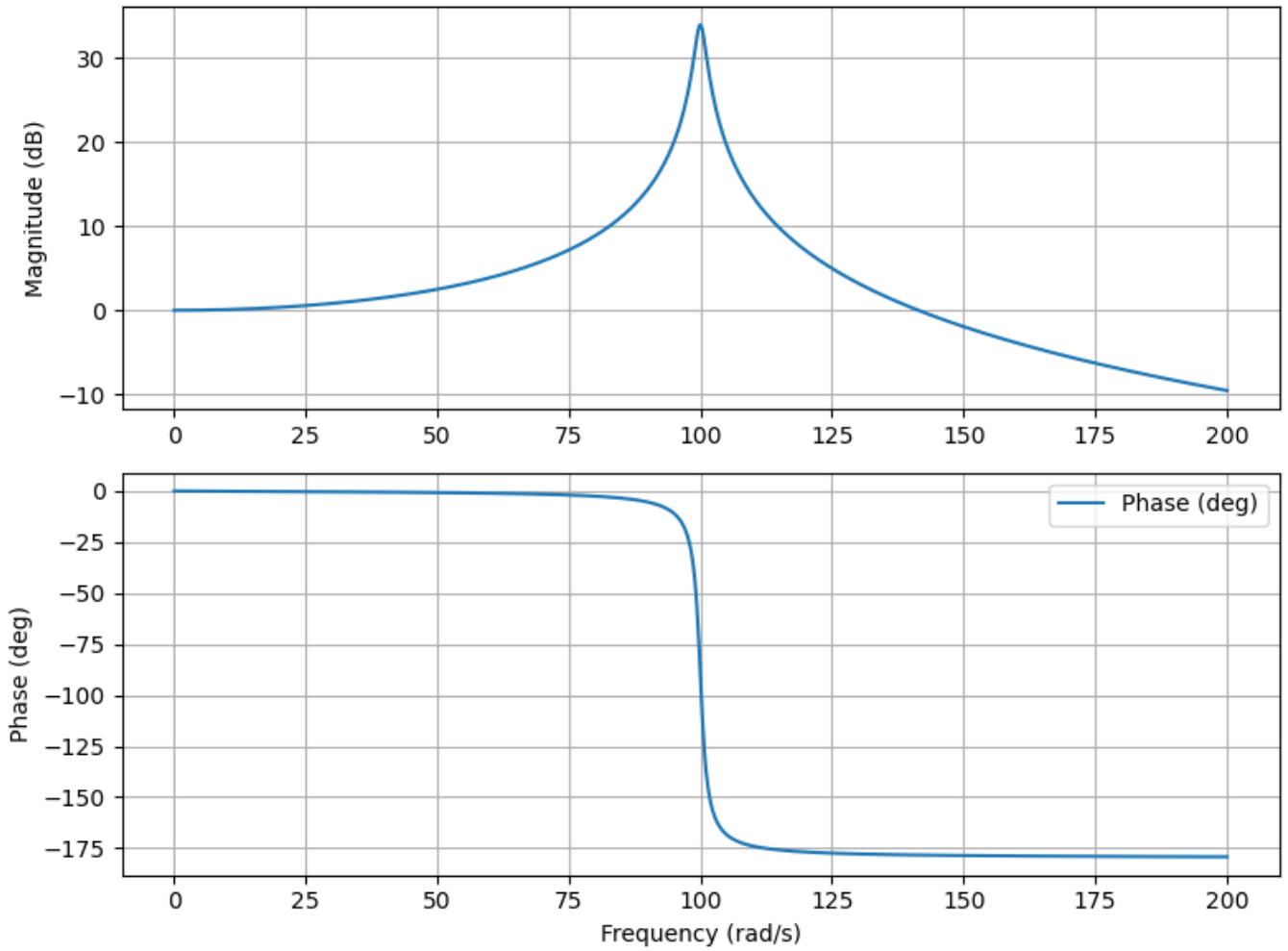


Fig. 1: Bode plot of a $\frac{10000}{s^2+2s+10000}$

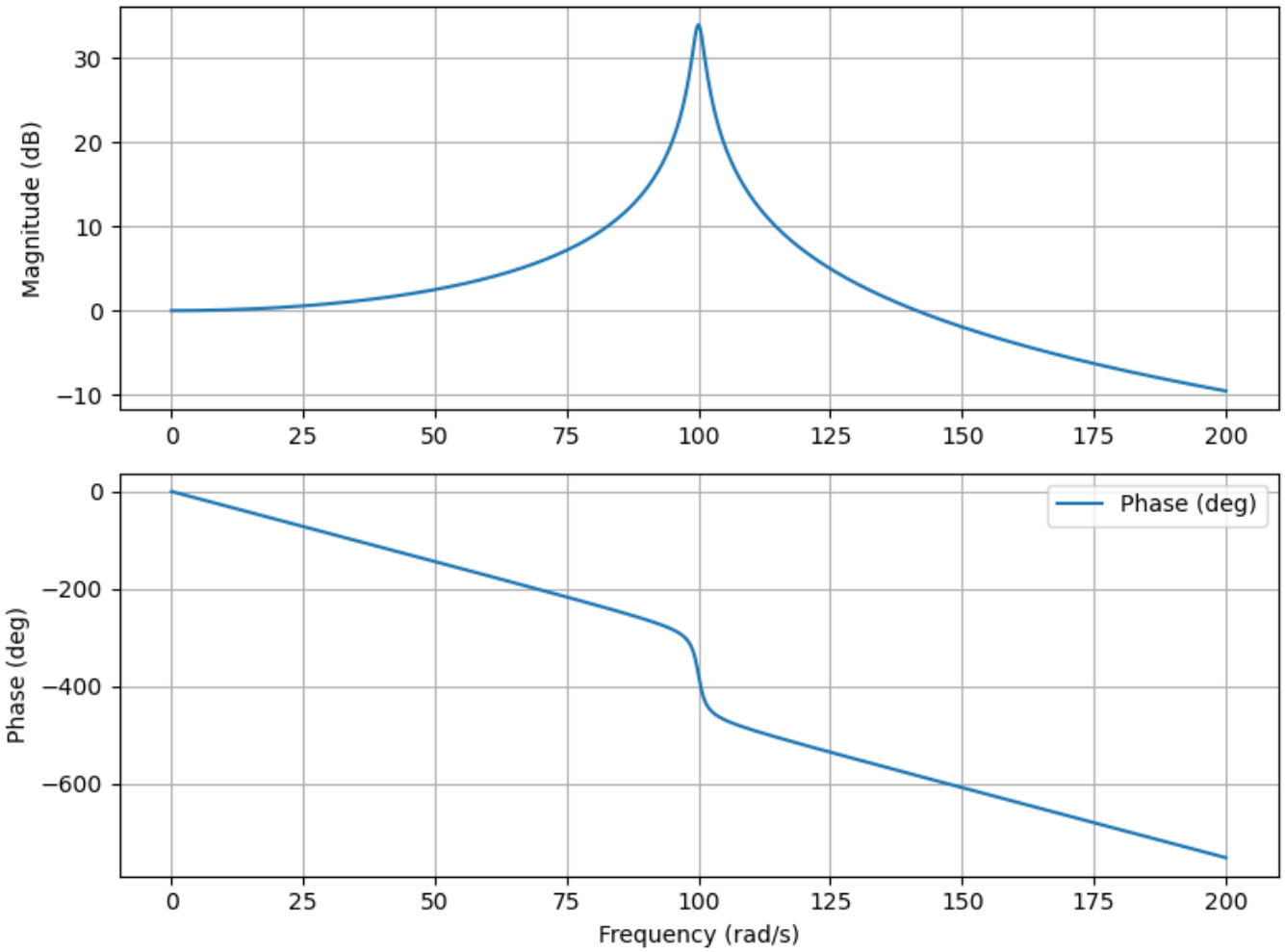


Fig. 2: Bode plot of a $\frac{10000e^{-0.05s}}{s^2+2s+10000}$

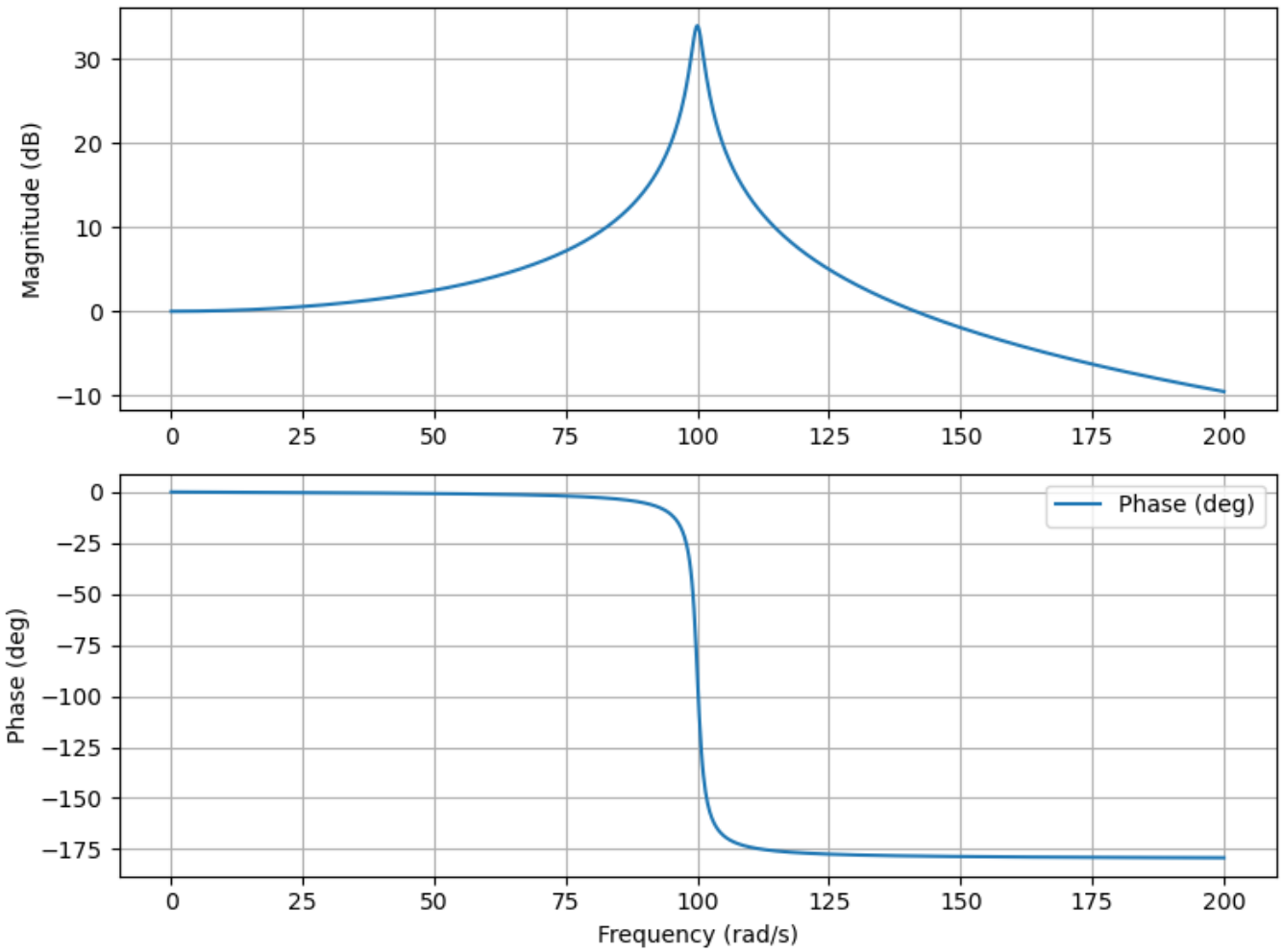


Fig. 3: Bode plot of a $\frac{10000e^{0.5\times10^{-12}s}}{s^2+2s+10000}$

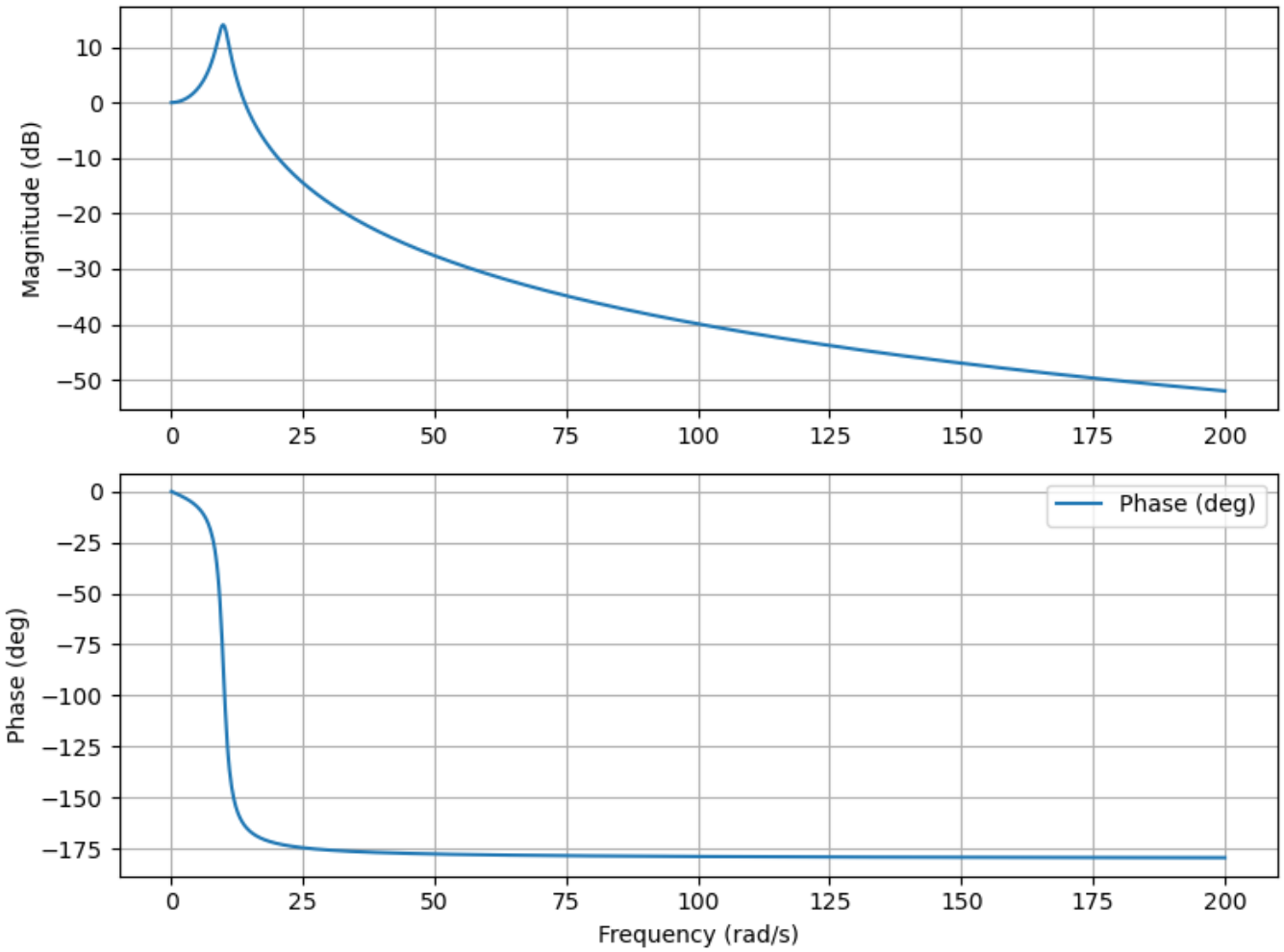


Fig. 4: Bode plot of a $\frac{100}{s^2+2s+100}$