

Q4

A

$$|H_n(\omega)| = \frac{1}{\sqrt{1 + \left(\frac{\omega}{6000}\right)^4}}$$

1 point

from
Tables

$$H_n(\omega) = \frac{1}{\left(\frac{\omega}{6000}\right)^2 + \frac{\sqrt{2}\omega}{6000} + 1}$$

2 points.

B

$$-2\text{dB} = 10^{\frac{-2}{20}} = \frac{1}{\sqrt{1 + \left(\frac{\omega}{6000}\right)^4}}$$

$$10^{\frac{-2}{20}} \left(1 + \left(\frac{\omega}{6000}\right)^4\right) = 1$$

$$1 + \left(\frac{\omega}{6000}\right)^4 = \frac{1}{0.94427} \approx 1.059$$

$$\frac{\omega}{6000} = \sqrt[4]{1.059} \approx 1.014$$

$$\omega = 6000 \times 1.014$$

$$\omega = 6084 \text{ Hz}$$

$$B \quad -20 \text{ dB} = 10^{-\frac{20}{20}} = \frac{1}{\sqrt{1 + \left(\frac{\omega}{6000}\right)^4}}$$

$$10^{-2} \left(1 + \left(\frac{\omega}{6000}\right)^4\right) = 1$$

$$\frac{\omega}{6000} = \sqrt[4]{100-1}$$

$$\omega = 18,970 \text{ Hz}$$