(c) The dispersion relation is $\left(\frac{n\pi}{b}\right)^2 = \omega^2/c^2 - k^2$

We get the phase velocity from

$$v_{ph} = \frac{\omega}{k} = \frac{\omega}{\sqrt{\omega^2/c^2 - \left(\frac{n\pi}{b}\right)^2}} = c \cdot \frac{\omega}{\sqrt{\omega^2 - \left(n\pi c/b\right)^2}}$$

So $v_{ph} > c$ always, unless $\omega > \frac{n\pi c}{b}$ where things break down. We identify this as the cutoff frequency

The group velocity comes from:

$$v_g = \frac{d\omega}{dk} = \frac{d}{dk}\left(\sqrt{\left(\frac{n\pi c}{b}\right)^2 + k^2c^2}\right) = \frac{1}{2}\left(\left(\frac{n\pi c}{b}\right)^2 + k^2c^2\right)^{-1/2} \cdot \cancel{2}kc^2$$

$$= \frac{kc^2}{\sqrt{\left(\frac{n\pi c}{b}\right)^2 + k^2c^2}} = c \cdot \frac{k}{\sqrt{\left(\frac{n\pi}{b}\right)^2 + k^2}}$$

which is certainly less than c. Subbing in for k + k^2 in terms of ω, we can also express v_g as

$$v_g = c\sqrt{1 - \left(\frac{n\pi c}{\omega b}\right)^2}$$