For TE_{mn} modes in a rectangular waveguide we had the dispersion relation

$$\frac{\omega^2}{c^2} - k^2 = \left(\frac{m\pi}{a}\right)^2 + \left(\frac{n\pi}{b}\right)^2$$

For the case $a = 2b$, waves with $\omega = 1.01c\pi/b$ are input to the waveguide. Which TE_{mn} modes admit a propagating solution?

A. Only TE_{10}
B. All modes, except TE_{10} and TE_{01}
C. Only TE_{10} and TE_{01}
D. None of the above
E. Not enough information

Waveguide sim link:

http://www.falstad.com/embox/guide.html

For TE_{mn} modes we found the general dispersion relation

$$k = \frac{1}{c}\sqrt{\omega^2 - \omega_{mn}^2} \qquad \text{with} \qquad \omega_{mn}^2 = \left(\frac{cm\pi}{a}\right)^2 + \left(\frac{cn\pi}{b}\right)^2$$

What is the phase velocity of the waves in the waveguide?

A. ω_{mn}/k
B. ω/k
C. c
D. $\sqrt{\omega^2 - \omega_{mn}^2}\,/k$
E. None of the above

For TE_{mn} modes we found the general dispersion relation

$$k = \frac{1}{c}\sqrt{\omega^2 - \omega_{mn}^2} \qquad \text{with} \qquad \omega_{mn}^2 = \left(\frac{cm\pi}{a}\right)^2 + \left(\frac{cn\pi}{b}\right)^2$$

How does the wavelength a TE mode compare to that of a plane wave in vacuum with the same frequency?

A. The TE mode wavelength is larger than the plane wave's.
B. The TE mode wavelength is smaller than the plane wave's.
C. The TE mode wavelength is the same as the plane wave's.
D. The answer depends on the actual value of the frequency.
E. The answer depends on the actual values of the side lengths.