Name________________________ SP436 Quiz

A sheet poster 2.00 m by 4.00 m is stretched over a rigid square frame such that the density is homogeneous and the tension is isotropic, resulting in a wave speed of 10.0 m/s.
We showed that:

$$\tilde{y} = \tilde{A}\sin(k_x x)\sin(k_z z)e^{j\omega t}$$

where:

$$k_{mn}^2 = \frac{n^2\pi^2}{L_x^2} + \frac{m^2\pi^2}{L_z^2}$$

What are the four lowest frequencies of the normal modes this sheet poster vibrates (in Hz)?

$$\omega_{mn} = c k_{mn} = c\sqrt{\frac{n^2\pi^2}{L_x^2} + \frac{m^2\pi^2}{L_y^2}}$$

$$f_{mn} = \frac{\omega_{mn}}{2\pi} = \frac{c}{2\pi}\sqrt{\frac{n^2\pi^2}{L_x^2} + \frac{m^2\pi^2}{L_y^2}}$$

$$= \frac{c}{2}\sqrt{\frac{n^2}{L_x^2} + \frac{m^2}{L_y^2}} = \frac{10}{2}\,\mathrm{m/s}\sqrt{\frac{n^2}{(2\,\mathrm{m})^2} + \frac{m^2}{(4\,\mathrm{m})^2}}$$

$$= 5\,\mathrm{m/s}\sqrt{\frac{4n^2}{16\,\mathrm{m}^2} + \frac{m^2}{16\,\mathrm{m}^2}} = \frac{5\,\frac{\mathrm{m}}{\mathrm{s}}}{4\,\mathrm{m}}\sqrt{4n^2 + m^2}$$

$$= 1.25\,\mathrm{Hz}\sqrt{4n^2 + m^2}$$

(m, n)			
1, 1	f_{11}	$= 1.25\,\mathrm{Hz}\sqrt{5}$	$= 2.80\,\mathrm{Hz}$
2, 1	f_{21}	$= 1.25\,\mathrm{Hz}\sqrt{8}$	$= 3.54\,\mathrm{Hz}$
3, 1	f_{31}	$= 1.25\,\mathrm{Hz}\sqrt{13}$	$= 4.51\,\mathrm{Hz}$
1, 2	f_{12}	$= 1.25\,\mathrm{Hz}\sqrt{17}$	$= 5.15\,\mathrm{Hz}$
2, 2	f_{22}	$= 1.25\,\mathrm{Hz}\sqrt{20}$	$\doteq 5.59\,\mathrm{Hz}$
4, 1	f_{41}	$= 1.25\,\mathrm{Hz}\sqrt{20}$	$= 5.59\,\mathrm{Hz}$

DEGENERATE

Follador Equations: $\omega = ck \quad f = \frac{\omega}{2\pi}$