**Answer on Question #69405-Physics / Other**

The phase velocity of transverse wave in a solid with atomic separation distance is given by $v_p = A\sin(kd/2)/(kd/2)$. Obtain an expression for the group velocity.

**Solution:**

The phase velocity

$$v_p = \frac{\omega}{k}.$$

Thus

$$\omega = v_p k = \frac{A\sin\left(\frac{kd}{2}\right)}{\left(\frac{kd}{2}\right)} k = \frac{2A}{d}\sin\left(\frac{kd}{2}\right).$$

The group velocity

$$v_g = \frac{d\omega}{dk} = \frac{d}{dk}\left[\frac{2A}{d}\sin\left(\frac{kd}{2}\right)\right] = A\cos\left(\frac{kd}{2}\right).$$

**Answer:** $v_g = A\cos\left(\frac{kd}{2}\right)$.