Question 5177

A fizzy drink can bobs up and down in water due to waves travelling across the surface. The waves travel at 0.7ms-1 and have a wavelength of 0.5m and an amplitude of 0.1m. Calculate the maximum velocity of the can?

Solution:

Lets write the equation for monochromatic wave, with given amplitude, frequency and wavelength:

$$y(x,t)=Asin(kx+\omega t)=Asin(\frac{2\pi}{\lambda}x+2\pi\nu t) \quad (1)$$

We can find the v_y , by differentiating (1):

$$v_y=\frac{\partial y}{\partial t}=A\cdot 2\pi\nu\cdot\cos(\frac{2\pi}{\lambda}x+2\pi\nu t) \quad (2)$$

Hence, the maximum v_y is

$$v_{y;max}=A\cdot 2\pi\nu \quad (3)$$

Also, we have a phase velocity for a monochromatic wave:

$$v_p=\frac{\omega}{k}=\lambda\cdot\nu \quad (4)$$

So, the maximum speed for the can is given by:

$$v_{max}=\sqrt{(v_{y;max}^2+v_p^2)}=\nu\sqrt{(4\pi^2A^2+\lambda^2)} \quad (5)$$

Using numeric values given, and putting it into (5), we obtain:

$$v_{max}=5.62\cdot 10^{-4}\frac{m}{s}$$