EJERCICIO F2BE2416:

Sentido negativo eje OX

$v = 20\ m/s$

$f = 20\ Hz$

$A = 10\ cm = 0{,}1\ m$

$y = A$ en $x=0$; $t=0$

a) Ecuación de la onda: ¡sentido negativo!

$$y(x,t) = A \cdot \operatorname{sen}(\omega t + kx + \varphi_0)$$

1) $\omega = \frac{2\pi}{T} \Rightarrow f = \frac{1}{T} \Rightarrow 20 = \frac{1}{T} \Rightarrow T = \frac{1}{20} = 0{,}05\ s$

$$\boxed{\omega = \frac{2\pi}{0{,}05} = 40\pi\ rad/s}$$

2) $k = \frac{2\pi}{\lambda} \Rightarrow v = \frac{\lambda}{T} \Rightarrow \lambda = v \cdot T = 20 \cdot 0{,}05 = 1\ m$

$$\boxed{k = \frac{2\pi}{\lambda} = \frac{2\pi}{1} = 2\pi\ rad/m}$$

3) $\varphi_0 = ?$ $\quad \begin{matrix} t=0 \\ x=0 \end{matrix} \Big\{ y = A = 0{,}1\ m$?!

$$y(x,t) = 0{,}1 \cdot \operatorname{sen}(40\pi \cdot t + 2\pi \cdot x + \varphi_0)$$

$$0.1 = 0{,}1 \cdot \operatorname{sen}(40\pi \cdot 0 + 2\pi \cdot 0 + \varphi_0)$$

$$\frac{0.1}{0.1} = \operatorname{sen}\varphi_0 \Rightarrow \operatorname{sen}\varphi_0 = 1 \Rightarrow \boxed{\varphi_0 = \frac{\pi}{2}\ rad}$$

$$\boxed{y(x,t) = 0{,}1 \cdot \operatorname{sen}\left(40\pi t + 2\pi x + \frac{\pi}{2}\right)}$$

b) Velocidad de un punto a $x = 0'2\ m$; $t = 0{,}25\ s$:

$$v(x,t) = \frac{d[y(x,t)]}{dt} = 0{,}1 \cdot 40\pi \cdot \cos\left(40\pi t + 2\pi x + \frac{\pi}{2}\right)$$

$$v(x,t) = 4\pi \cdot \cos\left(40\pi t + 2\pi x + \frac{\pi}{2}\right)$$

$$v(0{,}2;\ 0{,}25) = 4\pi \cdot \cos\left(40\pi \cdot 0{,}25 + 2\pi \cdot 0{,}2 + \frac{\pi}{2}\right) =$$

$$= 4\pi \cdot \cos\left(10\pi + 0{,}4\pi + \frac{\pi}{2}\right) =$$

$$= 4\pi \cdot \cos(10{,}9\pi)$$

$$v_{vibración} = 4\pi \cdot (-0{,}95)$$

$$\boxed{V = -11{,}95\ m/s}$$

c) Distancia si $\Delta\varphi = \frac{\pi}{2}$:

$\Delta\varphi = \varphi_2 - \varphi_1$ (mismo instante)

$$\frac{\pi}{2} = (40\pi t + 2\pi x + \varphi_0)_2 - (40\pi t + 2\pi x + \varphi_0)_1$$

$$\frac{\pi}{2} = 2\pi x_2 - 2\pi x_1$$

$$\frac{\pi}{2} = 2\pi (x_2 - x_1) \Rightarrow \boxed{x_2 - x_1 = \frac{1}{4} = 0{,}25\ m}$$

¡Precisamente la cuarta parte de la longitud de onda, ya que λ tiene una $\Delta\varphi = 2\pi$ rad y $\frac{\pi}{2}$ es la cuarta parte!