

Inlämningsuppgift 1

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a) Vågen rör sig i positiv x-led. - Annars skulle den ha gått längre än λ på $t < T$!

b) $y = A \sin(kx - \omega t)$

$$A = 0.8 \text{ mm}$$

$$\lambda = 1.2 \text{ m} \Rightarrow k = 2\pi \frac{1}{\lambda} = \frac{2\pi}{1.2} = 5.236/\text{m} \approx 5.24/\text{m}$$

Plastig biten loss ett litet element av strängens ges av

$$v_y = \frac{dy}{dt} = -A\omega \cos(kx - \omega t)$$

givet: $\max v_y = 0.75 \text{ m/s}$

$$\text{fås då } \cos(kx - \omega t) = \pm 1$$

$$\therefore v_y^{\max} = A\omega \Rightarrow 0.8 \cdot 10^{-3} \omega = 0.75$$

$$\omega = \frac{0.75}{0.8 \cdot 10^{-3}} \text{ /s} = 937.5 \text{ /s}$$

Vågens utbrednings hastighet ges av

$$v = \frac{\lambda}{T} = \lambda f, \text{ där } f = \frac{\omega}{2\pi}$$

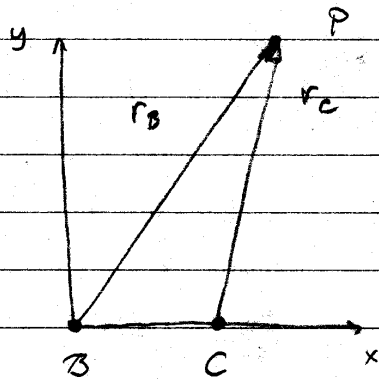
$$\therefore v = 1.2 \cdot \frac{937.5}{2\pi} \text{ m/s} = 179 \text{ m/s} \approx 180 \text{ m/s}$$

c) $y(x=2 \text{ m}, t=0.0006 \text{ s}) =$

$$= 0.8 \sin(5.236 \cdot 2 - 937.5 \cdot 0.0006) \text{ [mm]}$$

tid	wt	y(x=2,t)
1e-04	0.09375	-0.6523
0.0002	0.1875	-0.6061
0.0003	0.2813	-0.5546
0.0004	0.375	-0.4982
0.0005	0.4688	-0.4374
0.0006	0.5625	-0.3728
0.0007	0.6562	-0.3049
0.0008	0.75	-0.2343
0.0009	0.8438	-0.1617
0.001	0.9375	-0.0876
0.0011	1.031	-0.01278
0.0012	1.125	0.06216

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$$B: (0, 0)$$

$$C: (0.4, 0)$$

$$P: (0.5, 1.0)$$

$$y_B = A \sin(kr_B - \omega t)$$

$$y_C = A \sin(kr_C - \omega t + \frac{\pi}{2})$$

Fasstillägen i P:

$$\phi = (kr_B - \omega t) - (kr_C - \omega t + \frac{\pi}{2}) = k(r_B - r_C) - \frac{\pi}{2}$$

$$r_B = \sqrt{0.5^2 + 1.0^2} \text{ m} = 1.118 \text{ m}$$

$$r_C = \sqrt{(0.5 - 0.4)^2 + 1.0^2} \text{ m} = 1.005 \text{ m}$$

Konstruktiv interferens $\Rightarrow \phi = 0$ eller $n2\pi$

$$\phi = 0 \Rightarrow k(r_B - r_C) - \frac{\pi}{2} = 0$$

$$k = \frac{2\pi}{\lambda} \Rightarrow \frac{2\pi}{\lambda}(r_B - r_C) - \frac{\pi}{2} = 0$$

$$(r_B - r_C) = \frac{\lambda}{4} \Rightarrow \lambda = 4(r_B - r_C)$$

$$\therefore \lambda = 4(1.118 - 1.005) \text{ m} = 0.452 \text{ m} \approx 45 \text{ cm}$$

$$\phi = n2\pi \Rightarrow k(r_B - r_C) - \frac{\pi}{2} = n2\pi$$

$$\frac{2\pi}{\lambda} (r_B - r_C) = n2\pi + \frac{\pi}{2} = \left(2n + \frac{1}{2}\right) \pi$$

$$\Rightarrow \lambda = (r_B - r_C) \cdot \frac{2}{2n + \frac{1}{2}}$$

$$n=0 : \quad \lambda = 4 \Delta r$$

$$n=1 : \quad \lambda = \Delta r \frac{2}{2 + \frac{1}{2}} = \frac{4}{5} \Delta r$$

$$n=2 : \quad \lambda = \Delta r \frac{2}{4 + \frac{1}{2}} = \frac{4}{9} \Delta r$$