Uppgifter I2 28/9-11

(1) A guitar string 80.0 cm long has a mass density of 3.0 g/m. What is the velocity of waves on the string in m/s if the string tension is 87 N?

a. 88
b. 170
c. 256
d. 440
e. 200

(2) Find the speed of a wave propagating down a 500 meter long rope hung over a cliff at any distance y down the rope. The mass density of the rope is 0.5 kg/m.

a. $v = \sqrt{(500 - y)g}$
b. $v = \sqrt{2gy}$
c. $v = 0.5gy$
d. $v = \sqrt{0.5gy}$
e. $v = 0.5\sqrt{gy}$

(3) If $y = 0.02\sin(30x - 400t)$ (SI units), the velocity of the wave in m/s is

a. $\frac{3}{40}$
b. $\frac{40}{3}$
c. $\frac{60\pi}{400}$
d. $\frac{400}{60\pi}$
e. 400.

(4) For the wave described by $y = 0.15\sin\left[\left(\frac{\pi}{16}\right)(2x - 64t)\right]$ (SI units), the maximum displacement in m closest to the origin at time $t = 0$ occurs at $x =$

a. 16.
b. 8.
c. 4.
d. 2.
e. 13.

(5) When there is a node at $x = 0$ m, a maximum amplitude on a standing wave of wavelength occurs λ at $x =$

a. λ
b. $\frac{\lambda}{2}$
c. $\frac{\lambda}{3}$
d. $\frac{\lambda}{4}$
e. $\frac{\lambda}{5}$

(6) The longest wavelength that a standing wave can have on a stretched string of length L is

a. $2L$.
b. $3L$.
c. $5L$.
d. $7L$.
e. $9L$.

(7) Two harmonic waves are described by: $y_1 = 3.0\sin[(4x - 700t)\ \text{rad}]$ and $y_2 = 3.0\sin[(4x - 700t - 2)\ \text{rad}]$. What is the amplitude of the resultant wave?

a. 8.2
b. 4.3
c. 6.0
d. 3.2
e. 3.0

(8) Two harmonic waves are described by: $y_1 = 7\sin(5x - 100t)$ and $y_2 = 7\sin(5x - 100t - 2)$. What is the phase in rad of the resultant wave when $x = t = 0$?

a. 3
b. 0
c. 2
d. 1
e. 4

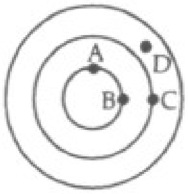
(9) Two harmonic waves traveling in opposite directions interfere to produce a standing wave described by $y = 2\sin(4x)\cos(3t)$ where x is in m and t is in s. What is the speed in m/s of the interfering waves?

a. 0.75
b. 0.25
c. 1.3
d. 12
e. 3.0

(10) The wave functions of two sound waves in air are $y_1 = 6.0\sin\left[\pi\left(\frac{2.0}{\text{m}}x + \frac{3.0}{\text{s}}t\right)\right]$ nm and $y_1 = 6.0\sin\left[\pi\left(\frac{2.0}{\text{m}}x - \frac{3.0}{\text{s}}t\right)\right]$ nm. What is the displacement in nm of the air molecules that have the equilibrium position $x = 0.030$ m when $t = 5.0$ s?

a. −3.88
b. −2.25
c. 0
d. +2.25
e. +3.88

(11) The figure below shows wave crests after a stone is thrown into a pond.

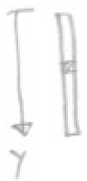


The phase difference in radians between points A and C is

a. 0.
b. $\frac{\pi}{2}$.
c. π
d. $\frac{3\pi}{2}$.
e. 2π.

① $v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{87}{3{,}0 \cdot 10^{-3}}}$ m/s $= 170$ m/s b)

---

② 

T minskar med y ∴ a)

---

③ $y = 0{,}02 \cdot \sin(30x - 400t)$ $\omega = v \cdot k$ el. $2\pi f = v \cdot \frac{2\pi}{\lambda}$

$v = \frac{\omega}{k} = \frac{400}{30} = 13{,}3$ m/s b)

---

④ $y = 0{,}15 \sin\left[\frac{\pi}{16}(2x - 64t)\right]$ $y = 0{,}15$ då $\sin\left[\frac{\pi}{16}(2x - 64t)\right] = 1$

$t = 0$ $\Rightarrow \frac{\pi}{16} 2x = (2n+1)\pi/2$ närmast origo $n = 0$ $\frac{\pi}{16} 2x = \pi/2$

$\Rightarrow x = 4$ c)

---

⑤ $y = 2A \cdot \sin kx \cdot \cos \omega t$ buk då $kx = \frac{\pi}{2}(2n+1)$ d)

närmast $x = 0$ $n = 0$ $kx = \frac{\pi}{2} \Rightarrow \frac{2\pi}{\lambda} x = \frac{\pi}{2} \Rightarrow \lambda = \frac{\lambda}{4}$

---

⑦ $y_1 = 3{,}0 \sin(4x - 700t)$ $y_2 = 3{,}0 \cdot \sin(4x - 700t - \varepsilon)$

d)

$y_1 + y_2 = \underbrace{2A \cdot \cos\frac{\phi}{2}}_{\text{ampl}} \sin\left(kx - \omega t + \frac{\phi}{2}\right)$

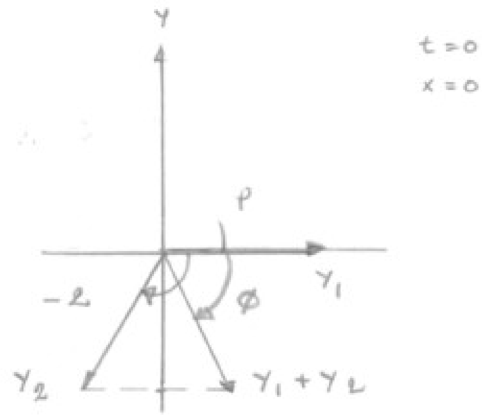
$2A \cdot \cos\frac{\phi}{2} = 2 \cdot 3{,}0 \cdot \cos\frac{\varepsilon}{2} = 3{,}2$

(8) $y_1 = 7{,}0 \sin(4x - 700t)$ $\quad y_2 = 7{,}0 \cdot \sin(4x - 700t - 2)$

Bestäm fasemp(i radianer) för den resulterande vågen $y_1 + y_2$ när $x = 0$ och $t = 0$.

Två metoder:

1) Visardiagram:



$$\tan\phi = \frac{\sin(-2)}{\cos(-2) + 1} \Rightarrow \phi = -1$$

2) $y_1 = 7{,}0 \cdot \sin[(4x - 700t - 1) + 1]$ $\quad y_2 = 7{,}0 \cdot \sin[(4x - 700t - 1) - 1]$

$\Rightarrow y_1 + y_2 = 2 \cdot 7{,}0 \cdot \cos 1 \cdot \sin(4x - 700t - 1)$ — om vi vill ange absolutbeloppet får vi 1

med $x = 0$ och $t = 0$ blir faset -1. dvs. (d)

---

(9) $y = 2A \cdot \sin kx \cdot \cos \omega t = 2 \cdot \sin 4x \cdot \cos 3t$ $\quad | \quad k = 4 \quad \omega = 3 \quad \Rightarrow v = \frac{\omega}{k} = 0{,}75\,m/s$

(a)

---

(10) Två motriktade vågor: stående våg. $\quad y_1 = A \cdot \sin(kx + \omega t)$, $\quad y_2 = A \cdot \sin(kx - \omega t)$

$\Rightarrow y_1 + y_2 = 2A \sin kx \cos \omega t = 2 \cdot 6{,}0 \cdot \sin(2{,}0\pi x) \cos(3{,}0\pi t)$ nm

utslag i $x = 0{,}030$ m vid $t = 5{,}0$ s: $2 \cdot 6{,}0 \cdot \sin(2{,}0\pi \cdot 0{,}030) \cos(3{,}0\pi \cdot 5) =$

$= 12{,}0 \cdot 0{,}187 \cdot (-1) = \underline{-2{,}25 \text{ nm}}$ (b)

---

(11) Cirklarna visar de ställen där fasen är $n \cdot 2\pi$

närbelägna linjer $\Rightarrow \Delta\phi = 2\pi$ (c)