chapter 16. 1, 8, 9, 15, 17, 52, 60

1. $\mu = 5\,g/cm^3 = 0.5\,kg/m$.

(1) $T = 10.0\,N$. $y_m = 0.16\,mm$

(2) $k = \frac{2\pi}{\lambda}$ $\lambda = \frac{v}{f}$ $v = \sqrt{\frac{T}{\mu}}$ 代入: $k = 2\pi \cdot \frac{f}{\sqrt{\frac{T}{\mu}}} = 140.43\,rad \cdot m^{-1}$.

(3) $\omega = 2\pi f = 628\,rad \cdot s^{-1}$

(4) sign in front of ω should be positive

8. (a). $l_a = L$ $l_b = 3L$. $\mu_A = \mu_B$.

$f = n \cdot \frac{v}{2l}$ $v = \sqrt{\frac{T}{\mu}}$ $f = n \cdot \frac{1}{2l} \cdot \sqrt{\frac{T}{\mu}}$

$f_{1,A} = \frac{1}{2L} \cdot \sqrt{\frac{T}{\mu}}$ $f_{n,B} = n \cdot \frac{1}{2l_b}\sqrt{\frac{T}{\mu}} = n \cdot \frac{1}{6L} \cdot \sqrt{\frac{T}{\mu}}$

$f_{3,B} = \frac{1}{2L} \cdot \sqrt{\frac{T}{\mu}}$ $f_{3B} = f_{1,A}$

(b) $f_{6,B} = f_{2,A}$ (1) 的2倍频率.

9. (a) $d = 5.6 \times 10^{-1}\,m$ $t = 8 \times 10^{-3}\,s$ $l = 0.1\,m$ $H = 8 \times 10^{-3}\,m$.

$y_m = 6\,mm$

(b) $k = \frac{2\pi}{\lambda}$ $k = 15.7\,rad \cdot m^{-1}$.

(c). $\omega = 2\pi f$ $v = \frac{d}{t}$ $\omega = 2\pi \frac{d}{t\lambda}$. 代入 $\omega = 10\pi \approx 4.5\,rad \cdot s^{-1}$.

(d). $y(x,t) = y_m \sin(kx + \omega t + \varphi_1)$.

$y_2(x,t) = y_{m2} \sin(kx + \omega t + \varphi_2)$.

$y'(x,t) = y_m \sin(kx + \omega t + \varphi_1) + y_m \sin(kx + \omega t + \varphi_2)$.

$= \underbrace{2y_m \cos\left(\frac{\varphi_1 + \varphi_2}{2}\right)}_{y'_m} \sin\left(kx + \omega t + \frac{\varphi_1 + \varphi_2}{2}\right)$. $\cos\left(\frac{0 + \varphi_2}{2}\right) = \frac{4 \times 10^{-3}}{2 \times 10^{-3} \times 6}$

$\therefore \varphi_2 \approx 2.46\,rad$.

(e) positive sign is needed

15. $\lambda = 0.18m$ $y = 4\times10^{-2}m$.

(a) $y(x,t) = y_m \sin(kx-\omega t+\varphi)$

$y(0,t) = y_m \sin(-\omega t+\varphi)$ 此处 $\varphi = \pi$.

$y(x,0) = y_m(kx+\varphi)$ 此处 negative sine function.

(b) $y_m = 0.04m$

(c) $k = \frac{2\pi}{\lambda} = 34.89\ rad\cdot m^{-1}$

(d) $\omega = \frac{2\pi}{T}$ $\omega = 0.628\ rad\cdot s^{-1}$

(e) $\varphi = \pi\ rad$

(f) $v = f\cdot\lambda$ (g). $v = 1.8\times10^{-2}\ m\cdot s^{-1}$. (h) $v = -y_m\omega\cos(-\omega t+\varphi)$

$v(0,t) = -2.5\times10^{-2}\ m/s$.

17. $\mu = 7.2g/m = $ ~~$0.72\ kg\cdot m^{-1}$~~ $7.2\times10^{-3}\ kg\cdot m^{-1}$.

(a) $T = 180N$.

$v = \sqrt{\frac{T}{\mu}} =$ ~~$1258.11\ m\cdot s^{-1}$~~. $158.11\ m\cdot s^{-1}$.

(b) $L = 60cm = 0.6m$.

(c). $f = \frac{v}{\lambda}$ $= 263.52Hz$.

5. $m = 0.13kg$ $T = 30N$. $L = 2.7m$ $y_m = 7.7\times10^{-3}m$

$P = \frac{1}{2}\mu v\omega^2 y_m^2$ $\mu = \frac{m}{L}$ $v = \frac{T}{\mu} = \frac{TL}{m}$ $\omega = 2\pi f$ $P = 170w$.

$P = \frac{1}{2}\frac{m}{L}\cdot\sqrt{\frac{TL}{m}}\,4\pi^2 f^2 y_m^2$ $f = 331.7Hz$

6. $t = 6\times10^{-3}s$ $D = 0.18m$ $H = 1.2cm = 1.2\times10^{-2}m$ $y(x,t) = y_m\sin(kx+\omega t)$

(a) $y_m = 0.6cm = 6\times10^{-3}m$ (b) $k = 20.93\ rad\cdot m^{-1}$ (c) $\omega = \frac{2\pi}{T} = \frac{2\pi}{2t}$

$= 523.3\ rad/s$

(d) negative