Chapter **14** *(Bueche & Jerde)* ***Vibrations and Waves***

P01 (**a**) $f = 19.0/97.3 = 0.195$ (Hz); (**b**) $\tau = 1/f = 1/0.195 = 5.12$ (s); (**c**) $A = 9.60$ (cm) .

P03 $k = F/x = 0.28/0.42 = 0.667$ (N/m); $U = (½)kx^2 = (½)(0.667)(0.0335^2) = 3.74\times10^{-4}$ (J) .

P05 $m = 0.250$ kg, $k = 120$ N/m & $A = 0.050$m. (**a**) At $x = 0$, $(½)mv^2 = (½)kA^2$, $v = A(k/m)^{1/2} = 1.10$ m/s; (**b**) $a = F/m = (k/m)A = 24.0$ m/s^2 .

P09 $m = 0.450$ kg, $v_{max} = 0.21$ m/s & $A = 0.042$ m. (**a**) $K_{max} = U_{max}$, $k = mv_{max}^2/A^2 = 11.3$ N/m; (**b**) $a_{max} = (k/m)A = 1.05$ m/s^2; (**c**) At $x = 0.030$ m, $v = [k(A^2-x^2)/m]^{1/2} = 0.147$ m/s & $a = (k/m)x = 0.750$ m/s^2 .

P14 $m = 0.85$ kg, $k_1 = 44$ N/m & $k_2 = 34$ N/m. $F = k_1x + k_2x = (k_1 + k_2)\,x \Rightarrow k_{eff} = k_1 + k_2$. $f = (1/2\pi)(k_{eff}/m)^{1/2} = (1/2\pi)[(k_1+k_2)/m]^{1/2} = 1.52$ Hz .

P15 $Y = (F/A)/(\Delta L/L) \Rightarrow F = (YA/L)\Delta L$ & $k = YA/L$. Thus, $f = (1/2\pi)(k/m)^{1/2} = (1/2\pi)(YA/Lm)^{1/2}$.

P16 $x = (18\text{ cm})\sin(3.7t)$: (**a**) $A = 18.0$ cm; (**b**) $f = \omega/2\pi = 3.7/2\pi = 0.589$ (Hz); (**c**) $\tau = 1/f = 1.70$ s; (**d**) $m = 0.520$ kg, $k = m\omega^2 = (0.520)(3.70)^2 = 7.12$ (N/m) .

P22 Let T be the tension in the string. At bottom point, $T - mg = m(v^2/L)$ and $T = 2mg \Rightarrow v^2 = gL$ …①. $E_1 = E_2$: $mgL(1-\cos\theta) = (½)mv^2$ or $v^2 = 2gL(1-\cos\theta)$ …②. From ① and ②, we find $\cos\theta = 1/2$, or $\theta = 60°$.

P26 $v = 25$cm/s: (**a**) $\lambda = 5.0$ cm; (**b**) $A = 0.6$ cm; (**c**) $f = v/\lambda = 0.25/0.050 = 5.00$ (Hz); (**d**) $\tau = 1/f = 0.200$ s .

P40 $f_n = nf_1$, $f_{n+1} - f_n = f_1 = 190$ Hz .

P41 (**a**) $f_1 = v/2L = 440$ Hz, $L' = 4L/5$, $f_1' = f_1(L/L') = 5f_1/4 = 550$ Hz; (**b**) $f_1'' = f_1(L/L'') = 1100$ Hz, $L'' = 2L/5$.

P43 $f = 120$ Hz, $L = 1.80$ m & $\mu = 0.65$ g/m. $f_n = (n/2L)(T/\mu)^{1/2} = (n/2L)(mg/\mu)^{1/2} \Rightarrow m = 4\mu L^2 f_n^2/(gn^2) = 12.38/n^2$ (kg). For $n = 4$, $m_4 = 0.774$ kg; for $n = 5$, $m_5 = 0.495$ kg; for $n = 6$, $m_6 = 0.344$ kg .

P46 Let y be the liquid height in the right side below the equilibrium position. $F = ma_y$ or $-(2yA\rho)g = (AL\rho)a_y$, $a_y = -(2g/L)\,y = -\omega^2 y$ referring to SHM. $f = \omega/2\pi = (1/\pi)(g/2L)^{1/2}$.

P47 $L_R = 2.75$ m and $L_L = 1.45$ m. $\tau = (½)t_R + (½)t_L = \pi(L_R/g)^{1/2} + \pi(L_R/g)^{1/2} = 2.87$ s, $f = 1/\tau = 0.348$ Hz .

小考,日期：94.03.22

1.某長方體(底面積為 250 cm^2)靜置於水平地面上，若於頂面向下均勻地施一 8 N 之力，則頂面之應力為 _____。

Ans. 應力 = 作用力/受力截面積 = 8 N/0.250 m^2 = 32.0 N/m^2 .

2. 已知水銀(海水)密度為 13.6 (1.025) g/cm^3，於海水中下潛____ m，水壓力將增加 1 atm。

Ans. 1 atm = $\rho_{Hg}gh_{Hg} = \rho_{sea}gh_{sea}$, (13.6)(0.760) = (1.025) $h_{sea} \Rightarrow h_{sea}$ = 10.1 m .

3.一 5 kg 之冰塊浮於水上，試計算其所受的浮力大小為_____。

Ans. $F_B = F_g$ = (5)(9.80) = 49 (N) .