Physics 1B HW#2

14.48) b) $f = \frac{1}{T}$

$f = \frac{1}{1.6s}$

$\boxed{f = 0.63Hz}$

c) $\omega = 2\pi f$

$\omega = 2\pi(0.63Hz)$

$\boxed{\omega = 3.9 rad/s}$

d) $\boxed{A = 6°}$

e) $\omega = \sqrt{\frac{g}{L}}$

$3.9\frac{rad}{s} = \sqrt{\frac{9.81\frac{m}{s^2}}{L}}$

$\boxed{L = 0.64m}$

f) no, mass is irrelevant

14.56) $x(t) = Ae^{-b/2m t}\cos(\omega t + \phi_0)$

$A = 0.100m$ @ $t = 5$

$x_0 = 0.500m$

$0.100m = 0.500m\left(e^{-b/0.110kg\,(5s)}\right)\cos(\omega t)$

$\omega = \sqrt{\frac{k}{m} - \frac{b^2}{4m^2}}$

$\omega = \sqrt{\frac{25\frac{N}{m}}{0.055kg} - \frac{b^2}{0.0121kg}}$ X

$0.100m = 0.500m\left(e^{-b/0.110kg\,(5s)}\right)$

$0.2 = e^{-b/0.110kg\,(5s)}$

$\ln(0.2) = -b/0.110kg\,(5s)$

$\boxed{b = 0.0354 kg/s}$

14.58) a) $\boxed{t = 0, 1, 2, 3, 4}$

b) $E_{total} = \frac{1}{2}kA^2$

$= \frac{1}{2}(225\frac{N}{m})(0.07m)^2$

$= \boxed{0.551 J}$

c) $E_1 = \frac{1}{2}(225\frac{N}{m})(0.06m)^2$

$E_1 = 0.405 J$

$E_4 = \frac{1}{2}(225\frac{N}{m})(0.03m)^2$

$E_4 = 0.101 J$

$\boxed{E_{lost} = 0.30 J}$

14.76) $\omega = \sqrt{\frac{k}{m}}$

$m = 1.67\times10^{-27}kg$

$\omega = 2\pi(7.0\times10^{13}Hz)$

$\omega = 4.398\times10^{14}\frac{rad}{s}$

$4.398\times10^{14}\frac{rad}{s} = \sqrt{\frac{k}{1.67\times10^{-27}kg}}$

$\boxed{k = 320 N/m}$

b) $v_{max} = \omega^2 A^2$

$\frac{1}{2}m\omega^2A^2 = 5\times10^{-20}J$

$\frac{1}{2}(1.67\times10^{-27}kg)v_{max}^2 = 5\times10^{-20}J$

$\boxed{v_{max} = 8000\frac{m}{s}}$

c) $v_{max} = \omega^2 A^2$

$7738.23\frac{m}{s} = \left(4.398\times10^{14}\frac{rad}{s}\right)^2 A^2$

$A = 2\times10^{-13}m$

$E_{total} = \frac{1}{2}kA^2$

$5\times10^{-20}J = \frac{1}{2}(320\frac{N}{m})A^2$

$\boxed{A = 2\times10^{-11}m}$

d) $\frac{2\times10^{-11}m}{1.6\times10^{-10}m} = \boxed{0.1}$

14.60) a) $A = \frac{F_{max}}{\sqrt{(k - m\omega_0^2)^2 + b^2\omega_0^2}}$

$A = \frac{F_{max}}{\sqrt{(k-k)^2 + 0.04km\left(\frac{k}{m}\right)}}$

$A = \frac{F_{max}}{\sqrt{0.04k^2}} = \boxed{\frac{F_{max}}{0.2k}}$

b) $A = \frac{F_{max}}{\sqrt{0.16km\left(\frac{k}{m}\right)}} = \boxed{\frac{F_{max}}{0.4k}}$

c) $A = \frac{F_{max}}{\sqrt{(k - \frac{m\omega^2}{4})^2 + 0.04km\left(\frac{\omega^2}{4}\right)}}$

$A = \frac{F_{max}}{\left(k^2 - 2k\frac{m\omega^2}{4} + \frac{m^2\omega^4}{16}\right) + 0.04k\left(\frac{m\omega^2}{4}\right)}$

$A = \frac{F_{max}}{\sqrt{\left(k^2 - 1.96k\frac{m\omega^2}{4} + \left(\frac{m\omega^2}{4}\right)^2\right)}}$ X

$\omega' = \sqrt{\frac{k}{m} - \frac{b^2}{4m^2}}$

$\omega_d = \frac{\omega'}{2}$

$A = \frac{F_{max}}{\sqrt{k \cdot \frac{1}{4}\left(\frac{k}{m} - \frac{b^2}{4m^2}\right)}}$

$\omega_d = \frac{1}{2}\sqrt{k/m}$

$A = \frac{F_{max}}{\sqrt{k \cdot \frac{1}{4}m\left(\frac{k}{m}\right) + 0.01k\left(\frac{k}{m}\right)}}$

$A = \frac{F_{max}}{\sqrt{(0.75k) + 0.01k^2}}$

$A = \frac{F_{max}}{0.757k} = \frac{1}{0.757} \cdot \frac{F_{max}}{k}$

$\boxed{1.32}$

d) $\frac{\frac{F_{max}}{0.2k}}{\frac{F_{max}}{0.757k}}$

$\frac{0.757}{0.2} = \boxed{3.78}$

e) $\frac{F_{max}}{\sqrt{(0.75k)^2 + 0.04k^2}}$

$\frac{F_{max}}{0.776k} = \frac{1}{0.776} \cdot \frac{F_{max}}{k}$

$\boxed{1.29}$

f) $\frac{0.776}{0.4}$

$\boxed{1.94}$

g) $0.20\sqrt{km}$ is greater

15.13) a) $y(x, t=0) = 0.3cm \cos\left(\frac{2\pi}{12cm}x\right)$

$y(0,0) = 0.3cm$

$y(1.5,0) = 0.212cm$

$y(3,0) = 0cm$

$y(4.5,0) = -0.212cm$

$y(6,0) = -0.3cm$

$y(7.5,0) = -0.212cm$

$y(9,0) = 0cm$

$y(10.5,0) = 0.212cm$

$y(12,0) = 0.3cm$

b) $y(x, t=0.4s) = 0.3cm \cos\left(\frac{2\pi}{12cm}(x - 2.4)\right)$

$y(0,0.4) = 0.09$

$y(1.5,0.4) = 0.27$

$y(3,0.4) = 0.29$

$y(4.5,0.4) = -0.14$

$y(6,0.4) = -0.09$

$y(7.5,0.4) = -0.27$

$y(9,0.4) = -0.29$

$y(10.5,0.4) = -0.14$

$y(12,0.4) = 0.09$

c) $y(x, t=0.8s) = 0.3m \cos\left(\frac{2\pi}{12cm}(x - 4.8)\right)$

$y(0,0.8) = -0.24$

$y(1.5,0.8) = -0.05$

$y(3,0.8) = 0.18$

$y(4.5,0.8) = 0.3$

$y(6,0.8) = 0.24$

$y(7.5,0.8) = 0.05$

$y(9,0.8) = -0.18$

$y(10.5,0.8) = -0.3$

$y(12,0.8) = -0.24$

15.18) a) $4830\frac{rad}{s}\,t = 2\pi$

$T = 0.00130\,s$

$f = 768.72\,Hz$

$172\frac{rad}{m}\,\lambda = 2\pi$

$\lambda = 0.0365\,m$

$v = \lambda f = 768.72\,Hz\,(0.0365\,m)$

$v = 28.08\frac{m}{s}$

$t = \frac{x}{v} = \frac{1.40\,m}{28.08\frac{m}{s}}$

$\boxed{t = 0.0499\,s}$

b) $v = \sqrt{\frac{F}{H}}$

$28.08\frac{m}{s} = \sqrt{\frac{W}{H}}$

$H = \frac{0.0135N}{g}$

$H = 0.001376\,kg/1.40\,m = 0.000983\frac{kg}{m}$

$28.08\frac{m}{s} = \sqrt{\frac{W}{0.000983\frac{kg}{m}}}$

$\boxed{W = 0.775N}$

c) $\lambda = 0.0365\,m$

$L = 1.40\,m$

$\boxed{N = 38}$

d) $A\cos(f(x) + g(t))$

15.28) a) $t = 0.015\,s$

$\Delta x = 0.6cm = 6mm$

shift right 6mm

$15\frac{m}{s} \times \frac{1sec}{1000m} \times \frac{40cm}{1sec} \times \frac{1m}{0.1cm} =$

b) fixed → reflects + inverts

$t = 0.02s$

$\Delta x = 8mm \rightarrow$ shift right 8mm

c) $t = 0.025\,s$

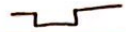
$\Delta x = 10mm$

d) $\Delta x = 12mm$

e) $\Delta x = 14mm$

f) $\Delta x = 16mm$

15.32) a) 

b) 

c) 

15.50) $v = \sqrt{\frac{F}{H}}$

$v = \lambda f$

$a = \omega^2 A\cos(kx - \omega t)$

$\omega = 2\pi f$

$a_{max} = \omega^2 A = g$

$a_{max} = 4\pi^2 f^2 A = g$

$g = 4\pi^2\left(\frac{v^2}{\lambda^2}\right)A$

$g = \frac{4\pi^2 F A}{H\lambda^2}$

$\boxed{A = \frac{H\lambda^2 g}{4\pi^2 F}}$