# Physics 1B HW #1

**14.5)** a) $f = 3.60\text{Hz}$, $A = 180\text{cm}$

$T = \frac{1}{f} = \frac{1}{3.60\text{Hz}} : 0.277\text{sec}$

$\frac{1}{4}T = \boxed{0.0694\text{sec}}$

**14.15)** $x(t) = A\cos(\omega t + \phi)$

$x(T/4) = 0$

$x(0) = A$

$\therefore \cos(\phi) = 1$

$\phi = 0$ or $\pi$

$x_0 > 0, v_0 = 0$

$\phi = 0$

$x(t) = A\cos(\omega t)$

$\frac{A}{2} = A\cos(\omega t)$

$\frac{1}{2} = \cos(\omega t)$

$x > 0, v < 0 \rightarrow$ QI

$\omega t = \frac{\pi}{3}$

$0 = A\cos(\omega \frac{T}{4})$

$\cos(\frac{1}{4}\omega T) = 0$

$\frac{1}{4}\omega T = \frac{\pi}{2}$

$\omega = \frac{2\pi}{T}$

$\frac{2\pi t}{T} = \frac{\pi}{3}$

$\frac{2t}{T} = \frac{1}{3}$

$2t = \frac{T}{3}$

$\boxed{t = \frac{T}{6}}$

$v(t) = -A\omega\sin(\omega t + \phi)$

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

$v(\frac{T}{4}) = v_{max} = -A\omega\sin(\frac{T}{4}\omega)$

$v(t) = -\frac{A}{2}\omega\sin(\frac{T}{4}\omega)$

$E = K + U \qquad U = \frac{1}{2}kx^2$

$E = \frac{1}{2}mv_{max}^2 \quad x(t)$

$-A\omega\sin(\omega t) = -\frac{1}{2}A\omega\sin(\frac{T\omega}{4})$

$\sin(\omega t) = \frac{1}{2}\sin(\frac{T\omega}{4}) \rightarrow \sin\frac{\pi}{2}$

$\omega t = \frac{\pi}{6} \qquad \frac{T\omega}{4} = \frac{\pi}{2}$

$t\omega = \frac{\pi}{6} \qquad T\omega = 2\pi$

$\boxed{t = 1/12\,T}$

**14.17)** $T = 2\pi\sqrt{\frac{m}{k}}$

$1.3\text{sec} = 2\pi\sqrt{\frac{42.5\text{kg}}{k}}$

$\left(\frac{1.3\text{sec}}{2\pi}\right)^2 = \frac{42.5\text{kg}}{k}$

$k = 992.8\frac{N}{m}$

$2.54\text{sec} = 2\pi\sqrt{\frac{42.5\text{kg}+x}{992.8\frac{N}{m}}}$

$\left(\frac{2.54\text{sec}}{2\pi}\right)^2 = \frac{42.5\text{kg}+x}{992.8\frac{N}{m}}$

$\boxed{x = 120\text{kg}}$

**14.28)** a) $U = K$

$\frac{1}{2}k(x(t))^2 = \frac{1}{2}m(v(t))^2$ x

$\frac{1}{2}E_{total} = U$

$\frac{1}{2}(\frac{1}{2}kA^2) = \frac{1}{2}k(x(t))^2$

$\frac{1}{4}kA^2 = \frac{1}{2}kx(t)^2$

$\frac{1}{2}A^2 = x(t)^2$

$\boxed{x(t) = \frac{\sqrt{2}}{2}A}$

b) $\frac{1}{2}E_{total} = \frac{1}{2}m(v(t))^2$

$\frac{1}{2}(\frac{1}{2}m\omega^2A^2) = \frac{1}{2}m(v(t))^2$

$\frac{1}{2}\omega^2A^2 = v(t)^2$

$\boxed{v(t) = \frac{\sqrt{2}}{2}\omega A}$

d) $-A\omega\sin(\omega t) = \frac{\sqrt{2}}{2}\omega A$

$-\sin(\omega t) = \frac{\sqrt{2}}{2}$

$\sin(\omega t) = \pm\frac{\sqrt{2}}{2}$

$\omega t = \frac{\pi}{4}$

$t = \frac{\pi}{4\omega}$

$\omega t = \frac{3\pi}{4}$

$t = \frac{3\pi}{4\omega}$

$\frac{3\pi}{4\omega} - \frac{\pi}{4\omega} = \frac{2\pi}{4\omega} = \boxed{\frac{\pi}{2\omega}}$

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

$U = \frac{1}{2}k(\frac{A}{2})^2$

$= \frac{1}{8}kA^2$

$\boxed{\begin{array}{l}U \text{ is } 25\% \\ K \text{ is } 75\%\end{array}}$

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

$\omega = \sqrt{\frac{365\frac{N}{m}}{2.00kg}}$

$\omega = 13.509\frac{rads}{sec}$

$x(t) = A\cos(\omega t + \phi_0)$

$v(t) = -A\omega\sin(\omega t + \phi_0)$

$0.200m = A\cos\left(13.509\frac{rads}{sec}t\right)$ ←

$-3.50\frac{m}{s} = -A\left(13.509\frac{rads}{sec}t\right)$ ×

$E_{total} = U + K$

$\frac{1}{2}kA^2 = \frac{1}{2}k(x(t))^2 + \frac{1}{2}m(v(t))^2$

$182.5\frac{N}{m}A^2 = 182.5\frac{N}{m}(0.04m^2) + 1.00kg\left(12.25\frac{m^2}{s^2}\right)$

$= 19.55Nm$

$\boxed{A = 0.327m}$

Max a when at amplitude

$a(t) = -A\omega^2\cos(\omega t + \phi_0)$ ← max = 1/-1

$a(t)_{max} = A\omega^2$

$= 0.327m(182.5sec^{-2})$

$= \boxed{59.7\frac{m}{s^2}}$

$F = -kx$ → at amplitude

$F_{max} = -kA = kA$

$= 365\frac{N}{m}(0.327m)$

$= \boxed{119N}$

14.38) $\tau = Fr\sin\theta$

$= 4.21N(0.11m)\sin 90$

$= 0.463Nm$

$\tau = K\theta$

$0.463Nm = K(0.0566rads)$

$\boxed{K = 7.87\frac{Nm}{rads}}$

$\omega = \sqrt{\frac{K}{I}}$

$I = \frac{1}{2}mR^2 = \frac{1}{2}(6.10kg)(0.11m)^2$

$I = 0.0369kgm^2$

$\omega = \sqrt{\frac{7.87\frac{Nm}{rads}}{0.0369kgm^2}}$

$\omega = 14.6\frac{rads}{sec}$

$\omega = 2\pi f$

$f = \frac{14.6\frac{rads}{sec}}{2\pi}$

$\boxed{f = 2.32Hz}$

$T = \frac{1}{f} = \frac{1}{2.32Hz} = \boxed{0.430s}$

14.62) $x(t) = A\cos(\omega t + \phi)$

$\omega = \frac{2\pi}{T} = \frac{2\pi}{0.260s}$

$\omega = 24.166\frac{rads}{sec}$

$\cos(\phi) = 1$

$\phi = 0$

$x(t) = A\cos(\omega t)$

$-0.0.15m = 0.0635m\cos\left(24.166\frac{rads}{s}t\right)$

$\boxed{t = 0.0749sec}$