1. A wave is represented by the equation $y = 0.2\sin 0.4\pi(x - 60t)$, where all distances are measured in centimeters and time in seconds. Find:
   a) The amplitude
   b) The wavelength
   c) The speed
   d) The frequency of the wave.
   e) What is the displacement at x = 5.5 cm and t = 0.02 sec?

(a) $A = 0.2\text{cm}$

(b) $k = \frac{2\pi}{\lambda} \Rightarrow \lambda = \frac{2\pi}{k} = \frac{2\pi}{0.4\pi} = 5\text{ cm} = 0.05\text{ m}$

(c) $v = \frac{\omega}{k} = \frac{60 * 0.4\pi}{1 * 0.4\pi} = 60\text{ cm/s} = 0.6\text{ m/s}$

(d) $v = \lambda f \rightarrow f = \frac{v}{\lambda} = \frac{60\text{ cm/s}}{5\text{ cm}} = 12\text{ Hz}$

(e) $y = 0.2 \sin\left\{0.4\pi\left[(5.5) - 60*(0.02)\right]\right\} = -0.15\text{cm}$

2. A transverse traveling wave on a stretched wire has amplitude of 5 cm, a frequency of 55.1 Hz, and travels with speed of 50 m/s.
   a) Write an equation in SI units of the form $y = A\sin(kx - wt)$ for this wave.
   b) If the mass per unit length of this wire is 40 g/m, find the tension in the wave.
   c) Determine the power transmitted to the wave.
   d) What is the magnitude of the maximum transverse velocity?
   e) What is the magnitude of the maximum transverse acceleration?

(a) $\omega = 2\pi f = 2\pi(55.1) = 346.2 \text{ rad/s}$

$v = \frac{\omega}{k} \Rightarrow k = \frac{\omega}{v} = \frac{346.2}{50} = 6.92 \text{ m}^{-1}$

$y(x,t) = 0.05 \sin(6.92x - 346.2t)$

(b) $\mu = 40 \text{ g/m}$

$v = \sqrt{\frac{T}{\mu}} \Rightarrow T = v^2\mu = (50)^2(40\times10^{-3}) = 100\text{N}$

(c) $P = \frac{1}{2}\mu\omega^2A^2v = \frac{1}{2}(40\times10^{-3})(346.2)^2(0.05)^2(50)$

$= 299.6\text{W}$

(d) $v_{max} = \omega A = 17.31 \text{ m/s}$

(e) $a_{max} = \omega^2 A = 5992.7 \text{ m/s}^2$

3. A transverse harmonic wave, with an amplitude of 2.0 cm, travels in the negative x direction with a speed of 30 m/s. At t = 0, a particle on the string at x = 0 has a displacement of 1.0 cm and an acceleration a = - 0.32m/s^2.
   a) What is the period of the wave?
   b) Determine the phase constant Φ.

(a) $y(x,t) = A \sin(kx + \omega t - \phi)$

$a(x,t) = -A\omega^2 \sin(kx + \omega t - \phi) = -\omega^2 y(x,t)$

$a(0,0) = -A\omega^2 \sin(-\phi) = A\omega^2 \sin\phi = -0.32 \text{ m/s}^2$ —(1)

$y(0,0) = A \sin(-\phi) = -A \sin\phi = 0.01 \text{ m}$ —(2)

$\frac{(2)}{(1)} \Rightarrow \frac{0.32}{0.01} = \omega^2 \Rightarrow \omega = 5.7 \text{ rad/s}$

$T = \frac{2\pi}{\omega} = \frac{2\pi}{5.7} = 1.10 \text{ sec}$

(b) substitute the value of ω in (1)

$(0.02)(5.7)^2 \sin\phi = -0.32$

$\sin\phi = -0.49$

$\phi = -29.5^\circ = -0.51 \text{ rad}$